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# ANNUAL REPORT

OF THE DIRECTOR  
EXPERIMENTAL FARMS SERVICE  
DEPARTMENT OF AGRICULTURE  
OTTAWA, CANADA



## EXPERIMENTAL FARMS SERVICE

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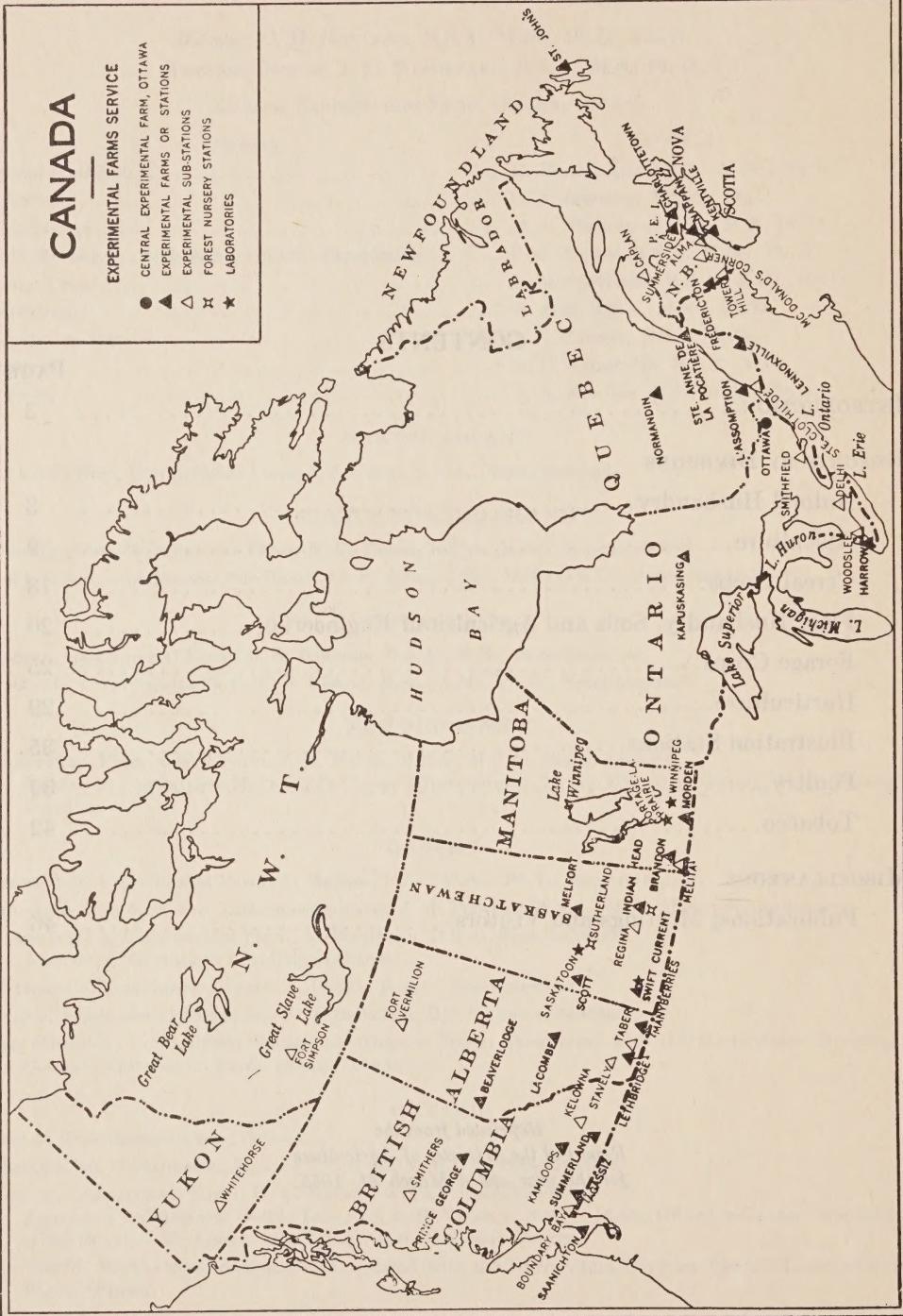
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*Reprinted from the  
Report of the Minister of Agriculture  
for the year ended March 31, 1955.*

CANADA

EXPERIMENTAL FARMS SERVICE

- CENTRAL EXPERIMENTAL FARM, OTTAWA  
 ▲ EXPERIMENTAL FARMS OR STATIONS  
 △ EXPERIMENTAL SUB-STATIONS  
 ✕ FOREST NURSERY STATIONS  
 ★ LABORATORIES



## EXPERIMENTAL FARMS SERVICE

Information is given in this section on results of experimental work conducted by the Experimental Farms Service in 1954-55 (projects of a continuing nature). A large proportion of these results are from and in most instances are the fruits of years of investigation. The co-operation of other services within the department, particularly of Science Service, and of other federal departments and agencies, as well as of provincial departments and other agricultural organizations is gratefully acknowledged. Highlights of the year's work are given under the nine Experimental Farms Divisions.

### ANIMAL HUSBANDRY DIVISION

#### BEEF CATTLE

*Grass Silage Satisfactory for Wintering Beef Cows.*—Pregnant beef cows can be carried through the winter satisfactorily on a ration of grass silage and hay. Two groups of pregnant cows at the Central Experimental Farm, Ottawa, were fed 9·5 pounds of hay per head daily, and in addition, cows in one group each received 43·5 pounds of grass silage, and in the other group 44 pounds of corn silage daily. Two-years' results showed no noticeable difference in the weight and vigor of the calves. The cows on grass silage lost more weight than those on corn silage, but the loss in weight appeared to be of little importance and all cows had more than recovered their weight the following fall. Analysis of the rations indicates that, although the two groups received the same amount of dry matter, the cows on grass silage and hay consumed on the average, three-quarters of a pound less total digestible nutrients daily than those on corn silage and hay.

*Grass Silage a Good Roughage for Wintering Beef Calves.*—At the Experimental Station, Lennoxville, Que., spring-born calves made a daily gain of 1·1 pounds when wintered on grass silage as the sole roughage, plus an average of 2 pounds of meal per head daily. With the same meal calves receiving hay alone, or grass silage and hay as roughage, gained 0·8 pounds per day. In the combined grass silage and hay ration, grass silage was fed at the rate of 3 pounds per 100 pounds liveweight. In the single roughage rations the roughages were fed ad libitum. The differences between rations have been consistent over a four-year period.

*Grass Silage Equal to Corn Silage for Wintering Beef Calves.*—Tests conducted at Ottawa, show that good mixed legume and grass silage, like corn silage, combines favorably with hay in a ration for wintering beef calves.

Two years' results show that calves which received about 1 pound of hay for every 100 pounds live weight, approximately 2 pounds of concentrate (75 per cent oats, 25 per cent wheat bran) per head daily, and either grass or corn silage fed to appetite, averaged a daily gain of 0·79 and 0·80 pounds, respectively. The cost per pound of gain was practically the same for both rations each year. At the end of the winter feeding periods both lots showed equally good development, bloom, and condition.

*Grass Silage with Hay Satisfactory for Wintering Beef Heifers.*—Yearling beef heifers can be carried satisfactorily through the winter on a ration of grass silage and hay, without grain. At Lennoxville, yearling heifers wintered on silage alone fed ad libitum, made an average daily gain of 0·8 pounds. Those on hay fed in the same manner made 0·7 pounds, and those fed hay ad libitum and grass silage at the rate of 5 pounds per 100 pounds live weight made a daily gain of 0·9 pounds. Although the differences are not very large, four years of consistent results indicate that yearling heifers, receiving no grain, do better on a mixture of hay and grass silage than on either roughage alone.

*Studies of Concentrate-roughage Ratios and Pelleted versus Non-pelleted Feeds for Fattening Beef Cattle.*—An experiment was carried out at the Experimental Station, Lethbridge, Alta., to study the effect of feeding concentrate and hay in the proportions of 2 to 1 and 1 to 2 on grain and feed efficiency of steer calves. The pelleting of the concentrate or the entire ration also was studied.

The steers fed a ration of 2 parts concentrate and 1 part hay gained approximately one-half pound more per head daily than those fed 1 part concentrate and 2 parts hay. The calves on the high roughage ration took approximately 8 weeks longer to reach 900 pounds and graded lower than those on the high-concentrate ration.

Pelleting of the concentrate or the entire ration resulted in more rapid gain, but the differences were not sufficient to pay for the cost of pelleting and the additional handling.

*Urinary Calculi Investigations.*—At the Range Experiment Station, Manyberries, samples of native pasture grass, hay, and water were collected from ranches in 1949 and 1950 and subjected to chemical analysis to determine the possible relationship between their content of certain minerals and the percentage incidence of calculi as reported by the ranches.

Analyses of feed and water did not indicate any clear trends in so far as the possible relationship between their chemical analysis and the incidence of calculi as reported is concerned. However, correlation coefficients between silica content of feeds and incidence of calculi were all positive but not high enough for statistical significance.

#### DAIRY CATTLE

*Studies of Rations for Dairy Calves on Limited Whole Milk.*—Meal rations for starting young dairy calves were compared in conjunction with feeding limited whole milk and replacing whole milk with reconstituted skimmilk at the Central Experimental Farm, Ottawa. The possible advantage of adding an antibiotic feed supplement (aureomycin) to the ration under different feeding systems also was tested. Preliminary results indicate that gains were slightly inferior when oats and barley replaced corn in the meal ration. Adding antibiotic to the meal ration at the rate of 1 per cent increased gains by 20 per cent during the first 6 weeks, but the effect of the antibiotic was less pronounced from 6 to 12 weeks of age. The increased gains achieved by continuing calves on reconstituted skimmilk from 6 to 12 weeks of age would not warrant the extra cost.

*Loose Housing Reduces Labor Requirements.*—The loose housing plan for dairy cattle compared favorably with the more costly standard type of stable at the Agassiz, Lethbridge, and Lennoxville experimental units. Although

bedding requirements were higher, cows that were loose-housed produced as well and required less labor than cows tied in stanchions. Over two-year period, the labor required per cow per day in the standard stable averaged 20 minutes, while an average of 16 minutes was required per cow with the loose housing plan.

*High Protein and Energy Content in the Dairy Ration increases Milk Yields.*—An experiment was conducted at Ottawa to study the influence of the level of protein relative to the energy content of the dairy ration on milk production. Four rations were used in which normal and high protein levels were each balanced with high and low energy. The highest milk yields were obtained when the ration containing a high level of protein also contained a high energy complement. The ration containing a high level of protein but low energy value did not stimulate milk yield so effectively as did a ration high in energy with normal protein content. The energy fraction of the rations had a greater net influence on milk yields than did the protein level.

*Environmental Variations Complicate Milk Production Evaluation.*—Milk production records in the Central Experimental Farm herd have revealed environmental variation due to freshening at different months of the year as well as to different years of freshening. By correcting production yields for these environmental effects more precise comparisons are being made in terms of breeding value. However, despite these corrections only 40 per cent of the total variation in production records is attributable to inherent differences among cows. The remaining 60 per cent of the variation can lead to misunderstanding regarding the breeding value of individuals unless averages of several records are available.

*Bull Semen Being Frozen for Wider Use.*—The technique of freezing bull semen is being applied at the Central Experimental Farm to prolong storage time and thus permit bulls to be tested simultaneously in widely located herds. A more accurate sire evaluation and selection will be possible.

#### DAIRY TECHNOLOGY

*Cheddar Cheese Flavor Elusive in Pasteurized Cheese.*—A comprehensive study of the factors affecting the flavor of cheddar cheese made from pasteurized milk was initiated in the past year. Initial results indicate that the method of manufacture of pasteurized milk cheese has been perfected to the extent that the resulting cheese is comparable to a high quality raw milk cheese in body and texture. The elusive cheddar cheese flavor, characteristic of raw milk cheese, has not been satisfactorily duplicated. This work is continuing as a co-operative project between Animal Husbandry Division of Experimental Farms Service, Bacteriology and Chemistry Divisions of Science Service, and Dairy Products Division of Marketing Service.

#### PASTURE

*Depleted Soils When Properly Managed Produce Good Yields of Pasture.*—The carrying capacity and productivity of depleted soils seeded to grass alone and to grass-legume mixtures are being studied by the Experimental Station, Beaverlodge, Alta. Non-fertilized grass-legume mixtures were superior to non-fertilized grass alone. Fertilizer markedly increased the yield of both. A brome-alfalfa mixture fertilized with 600 pounds of 11-48-0 has given the highest yield, with over 400 pounds of gain per acre (ewes and lambs) during 1954 and an average of 5,957 pounds of dry matter per acre (cage clippings) during 1953 and 1954.

Animal gains on these pastures have at times been seriously affected by an unknown agent that has caused scouring. There is reason to believe that parasites are involved.

*Chromic Oxide a Promising Indicator for Measuring Herbage Consumption.*

—A method for determining the dry matter intake of grazing animals is being studied at Ottawa. Part of the procedure is based on feeding an inert substance (indicator) to the animals and subsequently measuring the chemical concentration of the indicator in the fecal residues. One difficulty has been that when the indicator, for example, chromic oxide, was fed once daily it was excreted by steers and sheep in a non-uniform fashion which seriously limited its usefulness. Investigations have shown that diurnal variations in the pattern of excretion of this chemical can be eliminated by more frequent administration. Twice-a-day dosing was found to significantly reduce the variability in the excretion pattern as compared with once-per-day dosing. Dosing six times per day eliminated the diurnal variation. Improved procedures for administering the chemical to grazing animals still are being sought. It is expected that the chronic oxide technique will be valuable for estimating pasture yields and the efficiency of production of individual animals under grazing conditions.

*Carrying Capacity of Short-grass Range for Sheep.*—Three rates of grazing summer and winter short-grass range with sheep have been tested at the Range Experiment Station, Manyberries, namely, 0·8, 1·0, and 1·25 acres per ewe, per month. Under the climatic conditions that have prevailed during the experiment to date, the 0·8 acre per ewe per month rate approaches proper utilization. However, the overall level of utilization has been comparatively low because of exceptionally good forage production. To date there have been no significant differences in sheep production at the three rates of grazing.

*Grazing Studies on Irrigated Pastures in Southern Alberta.*—The productive capacity of four pasture mixtures, with and without fertilizer, was tested under irrigation during 1953 and 1954 at the Experimental Station, Lethbridge, Alta. The composition of these mixtures (pounds per acre) was as follows: (1) brome 7, orchard 7, creeping red fescue 7, ladino 3; (2) brome 7, orchard 7, creeping red fescue 7; (3) orchard 14, ladino 3; (4) alfalfa 5, reed canary 5, orchard 6, alta fescue 6. The fertilizer treatment was 100 pounds of 11-48-0 and 100 pounds ammonium sulphate per acre. Sheep were used to measure productivity.

Mixture (2), containing no legume, yielded less total digestible nutrients (TDN) than any of the other mixtures during both years. Mixtures (1), (3), and (4) yielded equally well. No increase in yield of TDN was obtained from the fertilizer treatment. Mixture (1), fertilized, produced TDN equivalent to 570 pounds of corrected gain during 1954.

*Factors Affecting Weight Losses of Cattle on Early Spring Pasture.*—Studies conducted at Ottawa indicate that approximately 50 per cent of the weight losses experienced by cattle when they first go on pasture in the spring is due to losses of rumen fill. Changes in daily weights of steers fed a normal hay and grain ration were compared with those of a similar group maintained on freshly clipped herbage during a two-week pre-pasture period. A second comparison was made during the first two weeks on pasture. The grass-fed steers lost over 3 per cent of their weight within the first two days after grass feeding was begun and lost an additional 3 per cent when placed on pasture. The group on the dry ration lost 7 per cent of their weight during the first two days on pasture. Since measurement of pasture production with animals is chiefly based on weights, these data emphasize the importance of an adequate pre-pasture conditioning period.

*Protein Level in Range Grasses Affects Rate of Gain in Yearling Cattle.*—Bi-weekly composite samples of native vegetation were collected at the Manyberries Range Station in 1949 and 1951. In both years the protein content declined from 9 to 10 per cent in June to 6 per cent in October. The protein content dropped below 7 per cent after the first week in September. Average daily gains of yearling steers on summer range were 0·93 pound when the grass contained less than 7 per cent protein, 1·80 pounds when the grass contained between 7 and 8 per cent protein, and 2·43 pounds when the grass contained more than 8 per cent protein.

Gain records of yearling steers on summer range from 1949 to 1953 showed steers gained 2·24 pounds per day from May 3 to July 11, 2·00 pounds per day from July 11 to September 5, and 1·07 pounds per day from September 5 to October 18.

#### SHEEP

*Increased Production From Open-faced Compared With "Wool-blind" Ewes.*—Results obtained at Lethbridge showed the open-faced Rambouillet ewes produced lambs that weighed five pounds more at weaning and sheared one-half pound more clean wool than wool-blind ewes. Partially or completely wool-blind sheep have difficulty feeding, are harder to handle, become lost more easily, and are more vulnerable to predators. Under range conditions this affects the number of ewes bred and the number of lambs weaned. Clipping for removal of face cover is not only time-consuming and expensive, but is only a temporary measure. Breeding off this excess wool is effective and permanent. The use of only open-faced rams and ewe lamb replacement stock is progressively successful.

*Studies of Grass Silage as Only Roughage for Sheep.*—Trials conducted at Lennoxville indicated that pregnant ewes wintered on grass silage alone produced as many lambs per ewe as those wintered on either silage and meal, silage and hay, or hay alone. However, those on silage alone required meal after lambing in order to feed their lambs, while the ewes on hay and silage or on hay alone raised their lambs without a meal supplement.

*Sources of Protein in the Ration of the Mature Ewe.*—Experiments at Lethbridge compared the relative value of linseed oilmeal, soybean oilmeal, cull peas, alfalfa meal, meat meal, lactalbumen (a milk protein) and urea (a synthetic, high-nitrogen compound) when fed to ewes during pregnancy and lactation. Lactalbumen was the most satisfactory, and urea the least satisfactory protein source. However, lactalbumen is not readily available and is expensive relative to the other sources of protein. When measured by lamb production there were no essential differences in linseed oilmeal, soybean oilmeal, cull peas, alfalfa meal, or meat meal.

*Performance and Progeny Testing of Rams.*—Sixteen Shropshire ram lambs at Ottawa were placed on a performance test at time of weaning, and records of gain kept for a 60-day period. On the basis of rate of gain during this period, weaning weight, and type classification, the six highest-scoring rams were assigned to breeding flocks. All rams were again put on feeding test at the termination of the breeding period, and individually fed for a further 70 days. Average daily gains were 0·5 and 0·7 pound in periods one and two, respectively, while the highest-testing ram in both periods gained 0·7 and 0·9 pound. In the progeny-tested group, the two lowest-gaining rams in both periods had the lowest average weaning weights on their lambs, while the highest-testing rams had the highest average weaning weights on their progeny.

## SWINE

*New Breed of Pigs Continues to Show Promise.*—The new breed of bacon hogs being developed at the Experimental Station, Lacombe, Alta., continues to show real promise. This breed is based on a foundation of Landrace  $\times$  Chester White  $\times$  Berkshire and is in its seventh generation. It is a white pig with a flop ear. In comparison with the Yorkshire it has shown superior rate of growth and equivalent carcass quality. It produces pigs that average one-half pound more at birth and about five pounds more at weaning than the Yorkshires. The crosses of the two breeds are superior in many respects to either pure breed.

*Evaluation of Ham Quality.*—At Lacombe, the simplest and most reliable measure of ham quality was found to be the percentage area of lean in the ham surface exposed when this cut is removed from the carcass in the routine slaughter procedure. Specific gravity of the ham was not so accurate for this purpose and was more difficult to obtain. Tapering hams, carrying weight well down to the hock, were found to be leaner than those that appeared plump through being well filled in the upper portion.

Ham quality was not associated with the Advanced Registry score for balance which is a measure of the relative proportions of ham, middle, and shoulder in the carcass. Amount of lean in the ham was, however, highly associated with the area of lean in the cross section of the loin muscle. Distinct breed differences in lean were noted in these studies at the Lacombe Station.

*Pasture for Swine Production.*—A preliminary investigation into the use of pasture in swine production has been completed at Ottawa. One lot of 72 pigs was self-fed the Advanced Registry rations on an annual pasture consisting of oats, rape, Italian rye grass, and sweet clover. A comparable lot was self-fed the same rations in a conventional piggery. The pigs on pasture took 10 days more to reach market weight than those in the piggery. Carcass quality and feed requirements were about the same for each group. It was evident that the pasture mixture used lacked palatability. This project will be continued using a legume-grass mixture.

*X-Ray Studies with Swine.*—Equipment has been obtained to study the use of X-rays in evaluating carcass quality in the living pig at the Experimental Station, Lacombe, Alta. Preliminary studies indicate that highly accurate measurements of back fat may be obtained by this method. Studies will continue to examine the rate of fat deposition and skeletal growth.

*The Feeding Value of Molded Cereal Grains for Swine.*—In order to determine whether molded cereal grains are satisfactory feeds for swine, digestibility studies involving growing fattening hogs were carried out at the Experimental Station, Lethbridge, on molded and non-molded oats and wheat. These studies show that No. 1 feed oats were digested to the extent of 65 per cent, while the digestibility of the molded and mildewed oats was only 54 per cent. It was also found that the digestibility of No. 5 wheat and molded wheat were 84 per cent and 87 per cent, respectively. Although molded grains are usually less palatable than non-molded grains, the results of these studies, especially with respect to the wheats, tend to indicate that molded grains are of greater value than price spreads usually indicate.

*Fish Silage of Value as a Protein Supplement for Hogs.*—Fish silage, a new by-product of the fishing industry in Nova Scotia, has been given preliminary tests as a protein supplement for hogs at the Experimental Farm, Nappan. In

feeding trials with growing and fattening hogs, the product was accepted readily by the hogs up to the rate of one pound of silage to three pounds of meal. Good gains and carcass grades were obtained. There were indications that off-flavors in the meat may result unless care in feeding is used.

*Alfalfa Meal Improves Rations for Self-Feeding Hogs.*—Several experiments over a period of years at the Lacombe Station have indicated that the inclusion of alfalfa meal in the ration of self-fed hogs improves carcass quality with no reduction in rate of gain. The best results were obtained when alfalfa meal made up 10 per cent of a standard ration comprised of the grains and a protein-mineral supplement. This level is recommended in rations from weaning to market weight.

*Small Amount of Grass Silage Valuable in Ration for Bacon Hogs.*—Studies on the feeding value of grass silage for bacon hogs, carried out, at Lennoxville indicate that the economy of feed utilization and the rate of gain by hogs were increased about 3·5 per cent by the addition of 10 per cent grass silage in the ration. At levels of 20 per cent and 30 per cent grass silage, the economy of gain was much the same as on a standard meal ration, but the rate of gain was decreased by 9 per cent.

#### APICULTURE DIVISION

The preliminary estimate of the 1954 honey crop in Canada was 19,898,000 pounds. This is the lowest production since 1926 and is approximately 6,000,000 pounds less than the 1953 crop. Only Manitoba and British Columbia produced average crops. In view of this situation the average return per pound of honey will be substantially higher than in recent years.

##### REDUCING STORAGE TIME FOR RECRYSTALLIZING HONEY

*Two-stage Storage.*—In processing recrystallized honey, high quality depends, among other factors, upon the speed with which the temperature of newly-seeded honey is reduced from 80° F. to 55°-60° F. A time-lag in excess of 36 hours in cooling to this range is common under present production methods where the cartons are stacked solidly at 57° F.

By using a two-stage-storage method a reduction in both the initial time-lag and the total storage time may be effected. The honey is held in primary storage at 40° to 45° F. for 24 hours and then removed to secondary storage (warehouse) at 60° to 70° F., where it is piled in solid blocks. On removal from primary storage it is found that the temperature of honey near the surfaces of the container has dropped to 48° F., while the temperature at the geometric center has been reduced only to 65° F. During the first few hours in the warmer secondary storage, there is a heat exchange between peripheral and inner honey so that the temperature of the inner honey is reduced.

In practice the honey temperature is reduced to, and remains in, the range 50° to 60° F. for 46 of the first 58 hours after seeding. By comparison, in the standard method, honey temperatures are in this range for only 26 of the first 58 hours.

The main advantage in this method is that the controlled temperature storage time is reduced from four days to one day. Similarly, a corresponding reduction in controlled temperature storage space may be effected.

*Ventilated Cases.*—Where it is desirable, because of present plant installations, to use 57° F. "cold rooms", another method of reducing the "incubation phase" of the recrystallizing process has been worked out.

In this procedure, one-inch holes are cut in the sides and ends of the cartons in line with the free space between the cans to provide cross-ventilation. In tests carried out at 57° F., the temperature of honey in the ventilated case dropped from 80° F. to 58° F. in 7 hours. The temperature of honey in standard cases under the same conditions was reduced to 58° F. after 24 hours' storage.

On removal to secondary storage, the effect of ventilation (which is undesirable here) may be eliminated by stacking the cartons solidly with the vents offset from each other.

*Viscosity Measurements Aid in Designing Honey Processing Equipment.*—As an aid in the development of new processing equipment, the kinematic viscosity of several types of honey (of varying densities) was measured with an Ostwald-Fenske viscometer. This instrument has an advantage over other types in that the viscosity values may be used directly—changes in specific gravity with temperature being corrected for in the calibration of the instrument.

The viscosities of typical samples of white, golden, and buckwheat honey were measured. The relationship between the logarithm of the viscosity and the temperature appears to be linear in the processing temperature range (80° to 180° F.).

Differences in viscosity among honeys of the same density, regardless of floral source, are negligible for all practical purposes. An exception is honey-dew honey which is considerably more viscous than any of the other honeys tested.

#### LEVULOSE SLOWS THE CRYSTALLIZATION OF HONEYS

Solutions of levulose, dextrose, and sucrose were made up in the same proportions and concentrations as they are normally found in domestic honey. After standard liquefaction treatments they were periodically examined and the appearance of dextrose crystals recorded.

From these data the "coefficients of crystallization" were worked out for three series of solutions having levulose to dextrose ratios of 1·30, 1·15, and 1·00, respectively.

Since all factors but the L/D variable were held constant, direct comparisons between series may be made and the probability of crystals appearing in any sample of a series may be predicted. For example, at four and one-half months after preparation, the chances of crystals forming in a sample in the L/D—1·00 series are twice as great as in the L/D—1·15 series and 5·3 times as great as in the L/D—1·30 series. Similarly, the probability of crystals forming in the L/D—1·15 series are 2·3 times as great as in the L/D—1·30 series.

Since the L/D ratio is the most important factor in the crystallization potential of honey, these values may be used in predicting the relative crystallization rates of any series of honeys that have been subjected to a standard processing treatment.

#### HONEYBEES INCREASE ALSIKE SEED PRODUCTION

An experiment was conducted in a commercial alsike seed-growing area near Beaverlodge, Alta., in 1954. Colonies of honeybees were located within three experimental fields at the rate of three, one, and one-half colonies per acre. The yield of seed in the field with the highest colony population was 15 times greater than the check field with no honeybees in the vicinity. With three colonies per acre the yield was 450 lb.; at one colony per acre, 370 lb.; at one-half colony per acre, 250 lb.; while the check field with no colony yielded only 30 lb. per acre.

## VALUE OF HONEYBEES FOR ALFALFA POLLINATION IS LIMITED

Studies conducted at the Regina Substation on the use of honeybees for the cross-pollination of alfalfa showed that some honeybees were active in tripping the flowers at all times, but the majority preferred to forage for nectar and pollen on other crops. The maximum honeybee activity on the alfalfa did not occur until there was a dearth of other flowering plants.

The production of seed was increased by 60 per cent on plots where five colonies of honeybees per acre were used as compared with plots containing three colonies per acre.

Honey production per colony, on the other hand, decreased as the number of colonies per acre was increased. The use of honeybees for the pollination of alfalfa in Canada is not considered to be economical in view of their low tripping activity and the significant reduction in honey yields with increased colony populations.

## HONEYBEES POLLINATE BIRDSFOOT TREFOIL

Fourteen colonies of honeybees were placed at the north end of a ten-acre field of birdsfoot trefoil when it commenced to bloom. Periodic counts were made to the number of honeybees and other pollinators on small plots located at appropriate distances extending the length of the field. A linear regression of honeybees was observed to extend from the hives to the south end of the field, similar to that which was found in red clover in 1952. Bumblebees and solitary bees were relatively constant over the entire field. No direct correlation between pollinator counts and seed yield was indicated for the distances studied.

Additional studies were conducted during a three-day period to determine the volume and concentration of nectar in the flowers of this plant. The average amount of nectar per floret was 0·09 microlitres, having a concentration of 33 per cent total solids.

## OTHER LEGUMES ATTRACT POLLINATORS FROM BIRDSFOOT TREFOIL

The admixture of alsike clover and red clover in a field of birdsfoot trefoil permitted a study of their relative attractiveness to pollinators. Observations conducted over a seven-day period showed that there were 103 honeybees on alsike clover as compared with 45 foraging on birdsfoot trefoil, while none were observed on red clover. Bumblebees were attracted to red clover with only two specimens seen working birdsfoot trefoil. Solitary bees showed a slight preference for alsike clover but also foraged on blossoms of birdsfoot trefoil and to a lesser extent, on red clover.

The amount of nectar available to bees in the florets of clover plants varies with the species. The average amount found in birdsfoot trefoil was 0·17 microlitres; 0·04 microlitres in alsike clover; and 0·38 microlitres in red clover. The average nectar concentration, expressed in total solids, was 32·9 per cent, 36·1 per cent and 40·4 per cent, for birdsfoot trefoil, alsike clover, and red clover, respectively.

## HONEYBEES PROVIDE ADEQUATE POLLINATION FOR RED CLOVER

Studies were continued in 1954 on the pollination of red clover. Pollinator populations in the vicinity of a 100-colony apiary showed an average of 1·19 honeybees and 0·24 bumblebees per square-yard area over a five-day period. Sample seed yields averaged 523 pounds per acre and the field yield was 245 pounds, showing a loss in harvesting of 46·8 per cent.

Honeybee colonies placed in the center of a 36-acre field and a smaller 12-acre field showed a linear regression of honeybees from the center to the outside of the large field but a uniform distribution over the small field. Bumblebee distribution showed a linear regression from the outside to the center of the large field and a uniform distribution over the small field.

The large field had an average of 83 heads per square foot, with 73 florets per head and 25 seeds compared with 73 heads per square foot, with 66 florets per head and 37 seeds per head for the smaller field.

#### TUBULAR HEAT EXCHANGER SATISFACTORY FOR PROCESSING HONEY

The experimental model was equipped for volume trials and demonstrated that temperatures and pressures could be satisfactorily controlled. A seed injection unit was constructed to pump the seed honey into the processing discharge pipes at varying rates and at varying temperatures. Processed honey was seeded at 80° F. and 57° F., stirred or left unstirred, and when stored at 57° F. the honey recrystallized satisfactorily in three days' time. A more uniform distribution of the seed into the discharge line by mechanical means will be given further trials.

A commercial unit, designed from the experimental model, for an independent packer to handle a ton of honey per hour, was assembled by him and put into operation in 1953. Failure to comply with the ratio of heating to cooling area suggested, resulted in the honey being cooled to 120° F. instead of 80° F. Installation of a pre-cool unit, in 1954, provided constant cooling temperatures between 76 and 78° F. at the discharge pipe. Heating temperatures between 170 and 175° F. were employed and pressure was maintained between 60 and 80 pounds. Honey containing a high yeast count was processed through this unit and when cultured showed sterility. Samples of honey after extracting contained 0·4 p.p.m. of copper and remained the same after processing through the copper coils. A seed injector is being designed for this unit in order that the complete process will operate on a continuous flow. The total cost of the whole unit will be in the neighbourhood of \$2,000.

#### EUROPEAN FOULBROOD DISEASE CONTROLLED BY ANTIBIOTICS

European foulbrood, which has become active in several of the beekeeping areas in Manitoba, Saskatchewan, and Alberta, in recent years, can be controlled by treating colonies with terramycin or streptomycin. Extensive experiments were conducted with these antibiotics at the Beaverlodge Experimental Station in 1954. Two treatments of 0·25 gram of terramycin applied as a spray, dust, or incorporated in a gallon of sugar syrup, gave excellent control. The treatments should be administered approximately two weeks apart.

Streptomycin gave the same degree of control with one treatment when applied at the rate of 0·5 gram per colony.

#### FUMAGILLIN IS EFFECTIVE IN CONTROLLING NOSEMA DISEASE

Nosema is a disease of the adult honeybee caused by the protozoan organism, *Nosema apis*. The greatest damage from this disease occurs to package colonies and to queens shipped in small cages.

The results of feeding fumagillin to package colonies have shown that infection in the bees was reduced from 50 per cent in check colonies to less than 3 per cent in treated colonies. The treated colonies developed normally and produced more honey than the check colonies.

Over-wintered colonies that were fed fumagillin in the fall and again in the spring did not produce more honey than check colonies although the incidence of disease was significantly decreased. It is believed that the development of colonies with large populations and their production potential are not seriously affected by this disease.

Fumagillin is marketed under the trade name of Fumidil B and is soluble in water. Beekeepers who import package bees should feed the antibiotic in sugar or honey syrups when installing the colonies.

#### HYBRID STRAINS SHOW PROMISE

Queens from hybrid strains were tested in Quebec, Ontario, and Manitoba against commercial stock. At Ste. Anne de la Pocatiere, Que., there was relatively little difference in brood development and egg viability between the hybrid and commercial strains. The commercial strain produced an average of 188 pounds of honey as compared with 163 pounds from the hybrid strain. At Ottawa the average production of 220 pounds was similar in both groups. In tests at the Brandon Experimental Farm, one hybrid (PXA) produced 30 pounds more honey per colony than the commercial stock, while another hybrid line produced an average of 31 pounds less than the commercial group.

The PXA line was the only outstanding superior hybrid tested in 1954.

### CEREAL CROPS DIVISION

Gratifying progress was made during the past year in perfecting and bringing into production better varieties of cereal grains and oil-producing crops. Work on four new varieties was completed and these were licensed for distribution. The four new varieties are Vantmore and Wolfe barleys, Raja flax, and Lake wheat.

#### SPRING WHEAT

The wheat crop situation in 1954 in Canada was most discouraging. Spring seeding, especially on the Prairies was delayed by cold and floods; rain in August and September, both in Eastern and Western Canada, prevented the crops from ripening and frost damaged many late-sown fields. Diseases, particularly leaf and stem rust, caused a greater reduction in yield and quality of cereal crops in Western Canada than in any previous year. Wheat yields in Eastern Canada were generally 30 per cent lower than in 1953.

#### BREEDING WHEATS FOR EASTERN CANADA

Progress was made in the development of lines of spring wheat for Eastern Canada resistant to leaf and stem rust. From 1000  $F_5$  head clusters of hybrid 5345, several were found with excellent resistance to leaf and stem rust. The stem rust resistance came from McMurachy, and the leaf rust resistance from Illinois 11 B8. Resistant lines from this single cross were used in two successive backcrosses with Acadia to restore adaptability, earliness, and yield. These resistant lines are again being crossed with other promising hybrids, varieties, and new introductions for the purpose of building up resistance to rust races.

#### PRELIMINARY YIELD STUDIES

The various components of yield of a number of varieties of spring wheat were studied at six different locations. The results indicated that the behavior of individual components is relatively uniform at all testing points. A knowledge of the reaction of each of these yield characters is of value in studies on the inheritance of yield. About 600 hybrid lines are now available for yield inheritance studies.

## SELKIRK WHEAT SITUATION VERY ENCOURAGING

By the end of the 1953 season the Canada Department of Agriculture had increased the seed of Selkirk wheat to 172,485 bushels. During the winter months of 1954 this seed was disposed of for seeding as described below.

A total amount of 157,200 bushels of seed was distributed to approximately 26,200 farmers in Manitoba and that part of Saskatchewan east of the third meridian. Six thousand bushels were allotted to the spring wheat area of the United States. The remainder, over 9,000 bushels, was reserved for increase under the control of the Department.

It is estimated that the 1954 crop from seed distributed to farmers, was over 3 million bushels.

The controlled increase in 1954 was carried out by the Experimental Farms, the P.F.R.A., and private contract growers, and produced approximately 220,000 bushels of seed. This seed was distributed during the winter of 1954-55 to farmers in Western Canada.

A further quantity of about 70,000 bushels of first generation Selkirk seed was produced by growers in 1954. Thus in all there will be from 3 to 4 million bushels of Selkirk wheat available for seeding in Canada in 1955.

## DURUM WHEAT

### TWO NEW STRAINS BEING INCREASED

Two new rust-resistant durum strains, D.T. 136 and D.T. 137, were considered worthy of multiplication and were increased during the winter months of 1954-55 in the Yuma Valley, Arizona. If either of these strains maintains its present record of macaroni quality, a new durum variety should be available for distribution soon.

### CHINOOK WHEAT REPLACING RESCUE

Chinook wheat, developed by the cereal breeders of the Experimental Farms Service at Lethbridge and Swift Current, was licensed in 1952 and distributed in 1953. By the end of 1954, sufficient stocks of certified seed were available to fill the immediate demands of Alberta and Saskatchewan farmers. Because of superior quality and eligibility for grade No. 1 Northern, Chinook is gradually replacing Rescue and is recommended for the sawfly areas of Alberta and Saskatchewan. Foundation seed has been produced and limited stocks of registered seed will be available from seed growers in 1955.

### SAWFLY-RESISTANT VARIETIES SOUGHT

In a search for new sources of resistance to wheat stem sawfly, a large number of varieties from various species of the *Triticum* genus, and hybrids from interspecific and intergeneric crosses have been tested.

## SOFT WINTER WHEAT

### DWARF BUNT NURSERY OPENED

A survey of the winter wheat areas of Ontario indicated that dwarf bunt was widespread but not so prevalent as in the previous year. In the search for resistant varieties, 73 named and numbered wheats were grown in a special nursery at Paisley, Ont. The average infection with dwarf bunt was 6 per cent while a susceptible check variety, Cornell 595, averaged 14 per cent. Several varieties showed resistance. The varietal reactions in general indicate

that resistance to dwarf bunt in Ontario may be inherited in a simple manner, and this will have to be corroborated under conditions of heavy infection. Several hybrid combinations have been made between dwarf-bunt-resistant and standard varieties. Selection is now being made in these hybrid populations.

The recently licensed variety, Genesee, developed at Cornell University, Ithaca, N.Y., is becoming popular in Ontario. This variety along with Dawbul is replacing much of the acreage formerly seeded to Cornell 595. Richmond continues to yield well in tests at Ottawa. Seed of this variety is being multiplied for distribution. The varieties named in this paragraph are high yielding, good quality, soft white wheats.

#### WINTER RYE

Antelope, a selection from Crown made at the University of Saskatchewan, and Dakold are the recommended varieties for the western provinces. Imperial and Horton are popular in the East. Tetra Petkus, a tetraploid winter rye variety that has shown promise in yield and straw strength in Ontario, was licensed in 1954.

#### FLAX

##### NEW OIL FLAX LICENSED AND AVAILABLE

The new linseed line 3901D selected at Ottawa was licensed this year under the name Raja. At present 1,200 bushels are available for distribution to farmers for seeding in 1955. This variety is early maturing and appears to be adapted to the Black soil zones of Manitoba and eastern Saskatchewan when late seeding is required.

##### EXTENSIVE SEARCH MADE FOR DISEASE RESISTANT PARENTS

An extensive survey is being made, both at Ottawa and Winnipeg for varieties or species resistant to pasmo. A large number of varieties and species of foreign origin have been screened during the past year. No resistant varieties were found. An interspecific hybridization program has been initiated at Ottawa. So far only hybridization between species with the same chromosome number has been successful.

Disease nurseries for flax wilt and pasmo have been very successful and of great assistance in the breeding work. This year, in addition, a successful field rust nursery was established at Ottawa.

Particular attention is paid to oil contents and oil quality of flax and this past season the iodine number of the crop has been especially high. A program has been started at Ottawa to test for the specific fractions of the fatty acids.

#### SAFFLOWER

##### NEW CROP RECEIVES PILOT TEST

Safflower seed produced at the Lethbridge station in 1953 was shipped to the Saskatchewan Co-operative in Saskatoon for crushing. About two tons of seed were given a pilot test to determine the value of safflower seed for both the edible and paint oil industry. A report is expected shortly.

A uniform test of eight varieties grown at seven stations was organized this year. The results indicated that the cool wet summer of 1954 was not favorable to this crop. Safflower is very sensitive to rain during blossoming

time so that yield per acre and germination of seed are severely affected. Selections that are less sensitive to rain will have to be found before this crop can be grown with safety on a large scale. Some varietal differences in maturity have been noted and further studies will be made on this aspect in the plant breeding program.

### BUCKWHEAT

#### NEW VARIETY OF BUCKWHEAT LICENSED

A new variety of smooth-hulled buckwheat of the Japanese type was increased at the Experimental Station, Lennoxville, Que. This variety, licensed as Tokyo, will be distributed to farmers for seeding in 1955. It is hoped that it will replace the rough-hulled varieties which are giving trouble to seed producers of other cereals.

Studies at Ottawa indicate that when lines of buckwheat are grown together there is an increase in yield per acre and also in size of seed. This study has now been arranged to test the specific combining ability of a group of the best yielding strains.

### FIELD BEANS

#### IMPROVEMENT PROGRAM EXTENDED

A co-operative nursery has been arranged with the Laboratory of Plant Pathology, Harrow, Ont., to test the disease reaction of new varieties and hybrids. In the past season this material was grown at two localities in the bean-growing area.

Many hybrids of the small bean type under test at Ottawa have shown considerable promise. An extensive hybridization program is under way and arrangements are being made to conduct disease tests on early generation material in the greenhouse. Although in the past our bean nurseries in the field have been subjected to artificial epiphytotics of blight and anthracnose, the tests in the greenhouse will be of great advantage in establishing resistant lines and varieties.

#### METHODS FOR THE CONTROL OF VIRUS DISEASES MADE AVAILABLE

In co-operation with the Plant Pathology Division, the Lethbridge station has made cultural methods for the control of virus diseases of beans available to farmers. The difficulty of applying cultural controls in wet fall seasons emphasizes the need for breeding resistant varieties. An intensive search for sources of resistance is now in progress at Lethbridge.

### OATS

The 1954 oat crop in Canada is estimated to be the lowest since 1947. In general, adverse weather was responsible not only for reduced yields but in many areas for poor quality.

#### VARIETY AND STRAIN TESTING

Since the crop year was abnormal for oats in a large part of the country in 1954, the tests of new varieties and hybrid strains were, in many cases, less reliable than usual. Many tests were seriously affected by such causes as lodging, army worms, black stem and excess moisture. The new varieties Rodney and Garry 27, licensed in 1953, have shown adaptability in many areas in Western Canada and also in Ontario, parts of Quebec, and in the

northern oat belt area of the United States extending from Minnesota to New York, but not in the Maritime Provinces. Both varieties perform particularly well under severe rust conditions. Scotian, also licensed in 1953, particularly for growers in Nova Scotia, did well in 1954 and test results indicate that it may be well adapted to parts of New Brunswick and possibly Prince Edward Island. A strain from a cross made at Ottawa in 1944 and involving Ajax, Roxton, Victoria, Banner, and Hajira as parents, has performed well in northern and eastern Ontario for several years and is being increased in 1955 at the Kapuskasing station. A new hybrid strain developed from a cross between Ajax and Abegweit made at Ottawa and re-selected at Fredericton, is also being increased at the Fredericton station in 1955.

In the West, the development of foundation stock seed of Rodney and Garry has been of major importance at the Cereal Breeding Laboratory, Winnipeg, particularly since it has been necessary to re-select Rodney for resistance to the new 7A race of stem rust. Under the control of the laboratory approximately 90,000 bushels of seed of Rodney oats were produced in 1953. Tests of improved hybrid strains developed at Agassiz, Indian Head, and Scott were included in the western co-operative oat group in 1954. The other strains in this group were developed at the Cereal Breeding Laboratory, Winnipeg.

#### BREEDING

Progress in oat breeding at the Central Experimental Farm involves the elimination of many hybrid strains from the breeding nursery because of susceptibility to rust, smut, weak straw, or small seed size. The main objective is to improve standard varieties by incorporating in them more resistance to disease and lodging along with larger seed size. Progress was made also in the search for resistance to black stem caused by the fungus *Septoria avenae*. Improvement in rust resistance in the widely grown variety Beaver has been obtained by backcrossing. Considerable success has already been achieved with interspecific hybridization among various *Avena* species. Further work is now in progress in an attempt to incorporate desirable germ plasm from the diploid species into cultivated varieties of oats. Some of the desirable characters carried by the diploid species are resistant to stem and crown rust, to black stem, and to other oat diseases.

Oat breeding work has been expanded substantially at the Charlottetown Station and a co-operative breeding project has been organized and centered at Charlottetown with co-operating stations at Nappan and Fredericton. The objective of this project is the improvement of oats for the Atlantic provinces.

In the West, the Cereal Breeding Laboratory at Winnipeg has carried on genetic studies on resistance to new races of rust, the results of which are valuable to the oat breeder in creating rust-resistant material. The stations at Scott, Sask.; Lacombe, Alta.; and Agassiz, B.C., have extensive oat breeding work under way with the object of developing improved varieties for their respective districts. The Lacombe station is concentrating on backcrossing with a view to developing earlier maturity in the variety Eagle and retaining its characters of high yield and lodging resistance. At Scott, the problem is largely one of early maturity and drought resistance. At Agassiz, lodging and disease resistance are of major importance.

#### BARLEY

The barley crop produced in Canada was smaller in 1954 than that of recent years due largely to unfavorable weather which delayed or prevented seeding and which made harvesting difficult. Diseases were very prevalent and

undoubtedly helped to lower the yield and quality. Montcalm has become the dominant malting variety. In Manitoba, in 1954, it was estimated that Montcalm occupied approximately 80 per cent of the barley acreage. The concentration of one variety over a large area is cause for concern when it has susceptibility to many diseases, and particularly when the weather has favored a rapid build-up of those diseases. Leaf diseases are causing particular concern. Plant breeders are alert to the situation and good progress was made during 1954 in advancing breeding programs that are designed to produce disease-resistant, high yielding barleys. However, the leaf diseases present a special problem since more work is needed on them to enable the plant breeder to locate sources of resistance and understand how to test new hybrid lines adequately.

#### TWO NEW BARLEY VARIETIES LICENSED

Vantmore was released through the barley breeding project for Manitoba and eastern Saskatchewan centered at the Experimental Farm at Brandon, Man. It is a 6-rowed, smooth-awned, variety originating from the cross Titan  $\times$  Vantage. It was formerly known as Br.597. It was developed as a feed barley to replace Vantage on the black soils of Manitoba. It seems to tolerate the root and leaf diseases better than Vantage and hence produces a crop that stands up well and yields better in Manitoba.

Wolfe was released by the Experimental Station at Lacombe, Alta. It is a medium-early, 6-rowed, smooth-awned feed barley produced by crossing a Sanalta  $\times$  Titan selection by a Montcalm  $\times$  Olli selection. It has out-yielded Olli consistently in central Alberta and appears to be especially adapted for production in that area.

#### CO-OPERATIVE BARLEY YIELD TESTS EXTENDED

The setting up of an Eastern Co-operative Barley Test in 1954 means that all regions of Canada are now covered by a co-ordinated testing program. It means that no variety or hybrid line will be tested in any part of Canada by either the Experimental Farms Service or the universities without other sections knowing about it and testing it before any stock of seed is built up. Western Canada is served by the Western Co-operative Barley Test which is also grown in Ontario and British Columbia. British Columbia has a co-operative testing arrangement involving the stations at Agassiz and Saanichton. The Peace River and areas farther north are in the Alcan testing project which is co-ordinated, in Canada, from the Experimental Station at Beaverlodge in co-operation with the U.S.D.A. in Alaska. The Canadian tests are at Beaverlodge, Alta., Fort Vermilion, Alta., Fort Simpson, N.W.T., and Whitehorse, Yukon. The new co-operative test in Eastern Canada was grown at 14 locations in 1954 and 25 varieties were tested.

#### EUROPEAN 2-ROWED VARIETIES TESTED

Many new varieties have been released in Europe since the war. Canada is always interested in testing outstanding varieties from other countries but there is additional interest, at present, since many new settlers in Canada enquire about growing varieties from their former land. A co-operative test of 2-rowed barley varieties has been organized at 4 eastern stations, 3 western stations, and at the Universities of Manitoba and Saskatchewan. Some of the new European varieties yield very well in Canada. Some have agronomic characters that make them undesirable such as very short straw, weak straw, or late maturity, but there is the possibility that others may find a place. There is particular interest in finding 2-rowed varieties that can succeed under

irrigation and particularly those with malting quality. There is a high degree of co-operation with the plant breeders of Western Europe and in many cases new varieties are made available for testing in Canada, even before they are named.

#### BARLEY FOR IRRIGATED LAND

The expanding acreage of irrigated land in southern Alberta has led to considerable interest in suitable cash crops for the new areas. The Experimental Station at Lethbridge is investigating the production of suitable malting barley on irrigated land. In general, the experiments show that barley under irrigation has larger kernels and is higher in extract and lower in saccharifying activity than dryland malting barley. It seems that a malting variety should be bred especially for growing under irrigation. A variety with slightly smaller kernels than Montcalm and a little higher saccharifying activity should be satisfactory.

#### BARLEY BREEDING EXPANDED IN THE ATLANTIC PROVINCES

The barley breeding program at the Experimental Station, Charlottetown, P.E.I., was expanded greatly in 1954 in order to serve the Maritime area. A project designed to create a disease-resistant, lodging-resistant, Charlottetown 80 type, 2-rowed barley is under way. The feasibility of producing a high-yielding 6-rowed barley that can be threshed as easily as Charlottetown 80 is being investigated. Jointworm resistance is being stressed for Prince Edward Island and several hybrid populations in the fourth generation were selected for resistance to infestation during 1954.

#### CANADIAN GENETIC STOCK COLLECTION

Arrangements were extended during 1954 by which all plant breeders in Canada will co-operate with the Cereal Crops Division in maintaining and improving this collection of barleys. All valuable stocks in existence in Canada will be added to it. A descriptive list of the entries in the collection was prepared for distribution.

#### RESULTS OF INTERSPECIFIC HYBRIDIZATION

Unusual success has been obtained as a result of pollinating *Hordeum leporinum* Link by *Hordeum vulgare* L. New barley-like segregates, with a winter habit of growth and resistance to certain diseases, have been obtained. These new barleys have been crossed and backcrossed to ordinary barley, and approximately one-half acre of winter barley segregates was seeded at Ottawa in the fall of 1954 for a test of winter-hardiness. The possibility of crossing some of the wild *Hordeum* species with common barley or with other species is being studied at Ottawa.

#### NEW EQUIPMENT DEVELOPED FOR CEREAL RESEARCH

Ingenuity has been displayed in developing equipment with which to speed up the work of seeding the thousands of cereal test plots seeded each year. Several branch farms and stations, as well as the Cereal Crops Division at Ottawa, have produced models that can seed four rows at a time and thus materially reduce the labor time needed to sow the plots.

## ARTIFICIAL GROWTH CHAMBER SPEEDS UP DEVELOPMENT OF NEW CEREAL VARIETIES

The Cereal Crops Division is one of the first institutions in the world to use artificial growth chambers for speeding up development of new cereal varieties. As the name implies the growing conditions for cereal plants in growth chambers are controlled. Temperature, day length, and fresh air supply can be changed at will. The fertility of the soil may be raised if necessary to suit the demands of the crop. Optimum growing conditions for all cereal crops and varieties have not yet been determined. However, for the most part, particularly with barley and spring and winter wheats excellent results are obtained. So far it has been possible to grow as many as five generations of barley within a year. Obviously these growth chambers will become indispensable as plant breeding problems become more complex.

### CYTOTOLOGY

Investigations by the cytogenetics section included, among others, the examination of species and hybrids in the genus *Hordeum*, a study of the chromosomes and nucleoli formation in *Pisum*, a study of sterility in cereals both from physiological causes and as a result of hybridization between species, and a preliminary examination into the causes of asynapsis in cereal chromosomes. Some other fundamental problems in cytology were studied also. The use of monosomics in genetic studies in spring wheat was continued and also extended to winter wheats. Barley stocks with homozygous chromosome translocations were crossed with two barley varieties to secure some information on gene control of smut resistance.

Cytological examination of rust spores at the Winnipeg Laboratory has shown that the three species of *Puccinia*—*P. malvacearum*, *P. asteris* and *P. xanthii* have eight chromosomes. These rusts belong to a group that has a simple life cycle. They differ in chromosome number from the rusts previously studied that have several types of spores and a complex life cycle with an alternate host.

## FIELD HUSBANDRY, SOILS AND AGRICULTURAL ENGINEERING DIVISION

Research work is conducted at the Central Experimental Farm at Ottawa and on most of the Branch Stations across Canada on various phases of Field Husbandry, Soils and Agricultural Engineering. Meteorological studies in relation to crop production are also the responsibility of this Division. Soil surveys are made to classify and map soils, to appraise their value for agricultural production, and to provide basic information for other investigations concerning methods of crop production. Other soil studies include tillage methods, fertility maintenance, and erosion control. Agricultural Engineering is concerned with studies of farm building construction and ventilation, drainage and irrigation, testing, adjusting and improving farm equipment and testing the utility and economy of these farming aids. Field Husbandry investigations cover different phases of weed control, silage and hay making, rotation studies, and cropping methods. Soil and crop management studies as well as processing methods with regard to fiber flax are investigated.

*New Plans for dairy cattle and sheep barns are being drafted.*—Floor plans for livestock buildings and equipment are being developed. These plans are being reviewed by livestock specialists on the basis of management, labor efficiency and utilization of equipment in handling milk, hay, silage, and manure.

*Swathing and the stage of maturity for cereal grains is being investigated.* Results of this experiment at Swift Current indicate that grains can be swathed when the kernel moisture is about 35 per cent with no detrimental effect on quality. As a result, harvesting can be advanced by approximately ten days.

*Experiments with surface drainage.*—Scoops and land levelers are being used on a Castor silt loam soil of Carleton County, Ont., to fill pockets and establish broad, shallow drains on flat land. Ditches are being installed at intervals of 75 to 200 feet. In 1954 it was possible to plant the surface-drained land 14 days earlier than the adjoining areas.

*Cultivators and their effect on trash cover are under study.*—In tests at Lethbridge cultivators with 16-inch sweeps maintained about the same amount of trash as wide blade cultivators under heavy trash conditions. However, under light trash conditions the 16-inch sweeps reduced the trash almost as much as the one-way disk.

*Self-feeding horizontal silos are being tested.*—The designs of horizontal silos and self-feeder racks are being studied in conjunction with a co-operative experiment in self-feeding cattle under winter weather conditions. A feeder rack fitted with bags over the opening reduces but does not eliminate freezing of the silage. Observations also indicate that the method of making silage may have an influence on the depth of frost penetration in self-feeding silos.

*Scaring devices for blackbirds tested in corn fields.*—Seven different methods and devices have been tested on farms in the vicinity of Ottawa for scaring birds. In these experiments exploders and noise makers were the most effective devices. Damaged cobs in unprotected areas ranging from 30 to 80 per cent were reduced to less than 25 per cent with this type of equipment but the cost of protection is relatively high.

*Special equipment is being developed.*—At the Saanichton station small threshers for plot work are being designed and constructed. Experimental machines for the packaging of holly are also being developed and racks have been devised for fumigating flower bulbs.

At Ottawa, equipment development included sprayers for weed control plots, knives and cutters for silage, wagon unloaders, and a tractor-mounted unit for seeding cereal grains in rod rows. A flax brake and stone picker are being tested at Swift Current.

*Long summer days in Northern areas compensate for lower temperatures.*—The relationship of the growth and development of certain cereal, horticultural, and forage crops to their meteorological environment is being investigated. This project is conducted on a nation-wide basis with the co-operation of Experimental Stations at Harrow, Ottawa, Normandin, Swift Current, Lacombe, Beaverlodge, Fort Vermilion, and Fort Simpson. Special consideration is being given to the effect of long summer days in northwestern Canada on crop production.

The analysis of data gathered during the past three years indicates that longer days, in general, hasten the rate of growth and development of wheat, thus compensating for the lower temperature in northern areas.

*Fiber Crops.*—The 1954 growing season was altogether one of the worst ever experienced in Eastern Canada. A little seeding was done early in May, but after that continuous rains stopped all seeding operations until too late

for planting fiber flax. This explains partly the lower acreage of fiber flax in 1954. The weather at harvest time was just as bad as in the spring and some of the crops were lost or damaged. Whatever fiber flax there was, however, produced a fair crop.

Only about 1,500 acres of flax were grown in 1954 in Quebec and Ontario for the production of fiber. The market conditions were slightly improved, while the prices of fiber remained about the same as in 1953. The remaining 1952 crop and all the 1953 crop was sold in the United States or disposed of through Canadian trade channels. No fiber was left for export to the United Kingdom.

The fiber flax variety "Wiera" important in Holland, has been introduced into our variety tests. From the results of only one year's trial it appears to be very resistant to lodging.

As tensile strength is just as important as the actual yield of fiber, a technique is being developed to determine, with the help of testing apparatus, the strength of fibers from various varieties, treatments, etc. The tensile strength of fiber is reflected in the hackling and carding yields during the spinning process.

*Increased use of newer herbicides for weed control.*—The use of 2,4-D and related compounds as selective herbicides for the control of broad-leaved weeds has become widespread. In recent years this Division has studied various herbicides with a view to finding controls for weed species that are not affected by 2,4-D. Considerable promising information has been obtained on a number of newer chemicals, and new techniques in the use of 2,4-D have been worked out. In Eastern Canada the control of weedy grasses, such as quack grass, in corn has heretofore required extensive cultivation or hoeing. Work at Ottawa and at L'Assomption, Que., indicates that very good control of these grassy weeds can be obtained by the use of 1½ to 2 pounds of CMU (a urea product) per acre. This chemical also shows promise for weed control in sugar beets, and in heavier applications it is useful as a soil sterilant.

At L'Assomption 8 pounds of T.C.A. and 6 pounds of Endothal as a pre-emergent spray gave excellent weed control in sugar beets without damage to beet seedlings. At Lethbridge, Alta., IPC has effectively controlled wild oats in sugar beets and canning peas. Maleic hydrazide is finding increasing use as a herbicide. The Station at Kapuskasing, Ont., has found that 8 to 16 pounds of the acid of M-H per acre will control quack grass without any residual soil sterilization. This practice is particularly valuable to home gardeners who wish to rid their gardens of quack without losing a year of production. Maleic hydrazide has also been used successfully to sterilize wild oats seeds growing as weeds in crops of barley or flax. The current season's wild oats plants are not eliminated but the wild oats seeds produced will not germinate whereas seeds from the crop plants are relatively unaffected. This work has not progressed beyond the experimental stage but gives hope for chemical control of wild oats which is Canada's worst weed.

MCP is a herbicide that is quite similar in properties to 2,4-D. However, work at Lacombe indicates that MCP is much more effective than 2,4-D in controlling hemp nettle (*Galeopsis tetrahit*) which is a serious weed in central Alberta. MCP also appears to be less damaging to peas and other legumes than is 2,4-D according to the results at a number of stations.

On the west coast it has always been difficult to obtain a seed field of clover free of volunteer grasses. This problem was solved at the Experimental Station, Saanichton, by spraying the infested field with 8 pounds of IPC per acre in the fall. The following season there were very few volunteer grasses on the treated area whereas on the untreated plots undesirable species made up 30 per cent of the stand.

Improved weed kills with 2,4-D on two relatively resistant species have been reported from the Prairie Provinces. In west-central Saskatchewan wild buckwheat is a serious weed and conventional spraying with 2,4-D has failed to control it. The Scott station has discovered that two sprayings at an interval of one week using 5 ounces per acre of the acid of a low volatile ester of 2,4-D at each spraying have given a promising control of the buckwheat and have not reduced the yield of wheat. At Morden, Man., field bindweed has been virtually eliminated on a field basis for three consecutive seasons by summer-fallowing the infested field until mid-July then allowing growth for three or four weeks before spraying with 12 to 16 ounces of 2,4-D ester acid per acre. One year's summerfallow without chemical treatment has been totally ineffective and conventional spraying with 2,4-D has given only partial control.

*Sprinkler irrigation greatly improves crop yields.*—Sprinkler irrigation is continuing its rapid expansion into the relatively humid areas. Often yields have been greatly improved by irrigation. At the Harrow station in southern Ontario the yield of early potatoes was more than doubled by supplemental irrigation. The data indicate that the yields are markedly decreased if the available moisture below the six-inch depth is in short supply. To keep available moisture at the optimum level required approximately one inch of irrigation water per week.

At Saanichton, B.C., pasture yields were raised from 4,827 pounds of dry matter per acre to 11,239 pounds by supplemental irrigation. The most favorable irrigation treatment consisted of a total of 10 inches of water in eight separate applications. Ladino clover was the outstanding legume under irrigation and orchard grass proved to be the most promising companion grass.

Sprinkler irrigation studies at Ottawa on large pastures grazed by dairy cows indicated an advantage of 55 per cent in carrying capacity attributable to irrigation. The dry-matter production showed a similar increase; 6,152 pounds per acre on the unirrigated portion and 8,740 pounds on the area that received 10 inches of irrigation water during the season.

*Alfalfa fields in Quebec show boron deficiency.*—Boron deficiency was found in 119 of the 266 alfalfa fields surveyed in the Ste. Anne de la Pocatiere district. Some 61 per cent of the affected fields were on light textured soils, 45 per cent on medium textured and 14 per cent on heavy soils. Tissue analyses indicated that the foliage must contain a concentration of boron of at least 15 parts per million to prevent the appearance of abnormal symptoms.

*Seaweed is a valuable manure substitute in the Maritimes.*—At Charlottetown, P.E.I., 20 tons of seaweed per acre was applied to a 4-year rotation. This amount of seaweed increased the yield of potatoes, clover hay, and timothy by about 75 per cent and the yield of barley by 25 per cent over the check plots. The experiment also included a treatment of 20 tons of cow manure and while yields from this treatment were higher than from the seaweed application the differences were not large.

*Higher rates of commercial fertilizer are indicated for hay and pasture.*—The Lacombe station reports that tests on the black loam soils of central Alberta have resulted in 100 per cent increase in hay yield following treatment with 75 pounds of 11-48-0 plus 360 pounds of 16-20-0. On black sandy loam the hay yields were increased 200 per cent by a similar fertilizer application. These results are more interesting when it is considered that at rates of 50 pounds or less (the usual rates) these fertilizers were ineffective.

The Experimental Farm at Agassiz, B.C., recommends that pastures in the lower Fraser Valley receive 40 pounds of nitrogen (125 pounds of ammonium nitrate) together with phosphate and potash early in the spring. Subsequent dressings of 20 to 40 pounds of nitrogen during the summer provide profitable increases and do not seriously lower the percentage of legume in grass-legume swards.

At Prince George, B.C., 100 pounds of 16-20-0 applied annually to a 4-year rotation of grain and hay have provided a net profit of \$7.50 per acre. Applying the fertilizer two years out of four gave a profit of \$6.26 per acre and one application in four years resulted in a net return of \$4.70 per acre. Thus on this relatively new land high rates of fertilizer are economical.

Forage production is a very important phase of agriculture in the area served by the Experimental Substation at Smithers, B.C. Experiments here have demonstrated that best forage yields are obtained with annual applications of 100 pounds per acre of 30-10-0 fertilizer.

*Placement of Fertilizer is receiving attention.*—At Lennoxville, Que., in a fertilizer experiment comparing drill placement versus broadcasting the results for 10 years show an average increase of 6.9 bushels of barley per acre per year in favor of the drill placement method. However at Scott, Sask., the placement of 50 pounds of ammonium nitrate directly with flax seed reduced the emergent stand by 23 per cent and the yield by 3.1 bushels per acre, a highly significant amount.

At Ottawa, side dressing of corn with fertilizer gave better returns than broadcast applications. This advantage amounted to about one ton improvement in yield per acre on silage corn and 6 to 8 bushels with grain corn. In studies on fertilizer application for oats, high rates of phosphorus fertilizer drilled in with the seed sometimes reduced the yield. However, there was no yield reduction when the same rates were applied broadcast.

*Regina plains clay soil responds to fertilizer application.*—The heavy clay soils of the Regina plains are some of Canada's most productive wheat lands. A long-term test on these soils shows an increase in yield of 2.9 bushels of wheat per acre on summerfallow from the application of 35 pounds of 11-48-0 fertilizer. Forty-five pounds of fertilizer provided an average increase of 3.9 bushels per acre. The respective profits per acre were calculated to be \$1.31 and \$1.91.

*Moisture relationships of prairie soils.*—The Soils Research Laboratory is studying moisture relationships in prairie soils. Because of higher colloidal content clay soils hold water much more tenaciously than lighter soils. Measurement of the force with which water is held by the clay soils indicates that the drought resistance of such soils is due more to this force than to a greater moisture-holding capacity. While clay soil will hold more total water than soils of lighter texture there is seldom sufficient precipitation to raise the moisture content of the loam soils to their maximum water-holding capacity. The average conservation in fallow fields is approximately the same for heavy loam, silt loams, clay loams, and clays under the precipitation of the Brown and Dark Brown soil zones.

*Soil Surveys provide basic soil information for land use.*—Soil surveys were continued in 1954 in all provinces in co-operation with the respective provincial Departments and colleges of Agriculture. Although excessive rain greatly hindered field operations in some areas, a total of approximately 4,000,000 acres was covered by systematic reconnaissance surveys during the season.

The reconnaissance surveys were conducted in the following areas during 1954: Avalon Peninsula, Nfld.; Inverness county, N.S.; parts of Victoria and Madawaska counties in the St. John River Valley, N.B.; L'Islet, Levis, Maskinonge, Papineau, and Lake St. John counties, Que.; parts of Lanark, Leeds, Frontenac, and Simcoe counties, Ont.; the West Lake area, Man.; the Elmwood area, Sask.; the Edmonton area and the Grande Prairie and Beaverlodge areas, Alta., and parts of the Columbia Valley and of the Peace River area, B.C. These systematic surveys provide a reliable inventory of our soil resources and give an indication of the various problems associated with the different soils.

In addition to the systematic surveys, preliminary soil investigations have been made in unsettled and remote areas in order to assess roughly the agricultural possibilities. Such work was conducted during the 1954 season in parts of Newfoundland in conjunction with the Royal Commission on Agriculture in that province, in the Fort Chimo area of northern Quebec in co-operation with the Department of Northern Affairs, in northern Manitoba at the request of the provincial Government and in parts of the Peace River region of Alberta and British Columbia. These preliminary surveys indicate which areas require further studies in regard to future possible development.

Detailed soil surveys were made of some 200,000 acres of land in connection with proposed irrigation projects in Alberta and Saskatchewan. The information on soils obtained by detailed examination provides a basis for the rating of soils in regard to their suitability for irrigation purposes, a rating it is of great importance to know before any actual irrigation development is undertaken. Detailed surveys were made also of 15 Experimental and Illustration Stations in various parts of the country to permit more precise investigational work at these centers and to provide a better guide for the application of the results.

In addition to the field surveys, chemical and physical laboratory studies were undertaken on representative soil samples collected during the survey. The analytical data serve as a guide in making a field classification of the different soils and help in the interpretation of various soil problems. During 1954 ten soil maps and 4 reprints were published.

#### FORAGE CROPS DIVISION

*Growth chamber speeds plant breeding program.*—Results secured from tests conducted in the Forage Crops Division, Central Experimental Farm, Ottawa, have made it possible to determine the value of artificially lighted growth chambers for the breeding of grasses and legumes. Five cycles of legume plant material have been grown, consisting of three lots of red clover, one of alfalfa, and one of alsike. Each lot was started in the greenhouse, transferred to the growth chamber before the onset of bloom and carried through the flowering period to seed maturity. In each case the time required to develop mature seed was reduced by 50 per cent as compared with plants kept under greenhouse conditions. To bring about cross-fertilization in the legumes a colony of honeybees has been introduced during the flowering period. Excellent seed setting has been obtained by this means even with alfalfa, which under field conditions is poorly cross-fertilized by honeybees.

One particular problem may be cited for which the growth chamber has proved useful. Tetraploid red clover which excels ordinary diploid red clover in vigor and yield is characterized by low fertility. But by repeated selection in successive generations this fertility has been raised from an average of

8 seeds per head in the F<sub>2</sub> generation to 46 seeds per head in the F<sub>6</sub> generation. The last three generations have been grown in the growth chamber. To reach the goal of normal red clover fertility which is about 60 to 70 seeds per head, would appear quite possible with a few more cycles of selection.

Thus the ability to grow several generations in a year speeds up the solution of such a breeding problem. The growth chamber will also prove of value in producing polycrosses under conditions of perfect isolation. Selecting for disease resistance and interspecific crossing are other phases of work to which it should prove well adapted.

*Progress being made in breeding anthracnose-resistant red clover.*—Northern anthracnose has become increasingly prevalent on red clover in central Alberta during the past three years. In comparative tests at the Lacombe station in 1954, the yield and quality of hay of twelve varieties of red clover was reduced on the average by 50 per cent as a result of the disease. A similar reduction in yield of seed was indicated by the number of infected stems having wilted or detached blossoms.

The severity of the disease has assisted greatly in the selection of resistant plant material. In 1954, only 230 of 4,400 plants of Siberian red clover were found to be comparatively free from infection.

Numerous selections from several different varieties have been checked for reaction to northern anthracnose under controlled conditions in the greenhouse. Their reaction to powdery mildew has been noted also since this disease is of considerable importance on red clover. Forty-seven of the best selections obtained from the varieties, Dollard, Ottawa, and Siberian are being progeny-tested. A number of these solutions are particularly promising and show a high degree of resistance to both northern anthracnose and powdery mildew. The development of one or more improved strains of red clover possessing marked resistance to these two diseases is expected within the next few years.

*New grasses prove to be useful forage crops in the Prairie Provinces.*—Three grasses, intermediate wheat grass, Russian wild rye grass and tall wheat grass, introduced from Russia some twenty-five years ago, have qualities that make them useful forage crops in the Prairie Provinces of Canada.

Intermediate wheat grass, a very palatable grass, has out-yielded crested wheat grass and brome grass on dry land over a five-year period at Swift Current, Sask. In mixture with alfalfa the yields of the three grasses were: intermediate wheat grass 1,697, crested wheat grass 1,458, and brome grass 1,332 pounds of dry matter per acre. In an irrigated pasture trial intermediate wheat grass in mixture with alfalfa and white clover put on more lamb gain per acre than any other grass in the test. Three disadvantages of the crop are: tendency to winterkill after dry falls and severe winters, low seed yield, and rapid loss of nutritive value after the flowering stage.

Russian wild rye grass, while not having the yielding ability of intermediate wheat grass, has several attributes in which it excels most other grasses and which make it especially useful as a pasture grass in dry areas. It is very long lived and hardy. Winterkilling of established stands has not been observed. As a pasture grass it has the commendable feature of having a high protein content which is maintained late into the fall and even until the next spring, after lying under snow all winter. For example, in one test Russian wild rye grass had a protein content of 7.1 per cent the next spring and crested wheat grass 3.4 per cent. It has the quality of "curing" with low lignification of the leaves. Cattle and sheep have shown a preference in the

pasture for Russian wild rye grass over other grasses late in the fall. Thus, Russian wild rye grass appears to fit into a pasture rotation with crested wheat grass wherein the latter is used early in the season and Russian wild rye grass after midsummer. Several tests conducted in the past have shown that Russian wild rye grass has the ability to withstand intense and frequent utilization without apparent damage to the stand, better than all other grasses tested. Seed of Russian wild rye grass is high priced and scarce. However, experiments conducted at several Experimental Stations in recent years have shown how seed of this grass can be successfully produced and in the near future more seed should become available to farmers in Western Canada.

*New "Golden" rape produces more oil per acre.*—A co-operative breeding program begun at the Forage Crops Laboratory, Saskatoon, Sask., about ten years ago culminated in the naming and licensing of the Golden variety of oil-seed rape in 1954.

High oil percentage of the seed is the outstanding characteristic of the Golden variety. As an average of nine tests conducted from 1949 to 1953 the seed of Golden had an oil content of 41·61 compared with 38·51 per cent for that of Argentine. In tests conducted in 1954 the difference was even greater, amounting to about 5 per cent. The oil of Golden is slightly lower in iodine value than Argentine. In yield of seed Golden averaged about 10 per cent better than Argentine in the nine tests referred to above. In tests conducted in 1954 its advantage in this respect was not so large as formerly but it was still slightly superior to Argentine.

Golden's combination of higher oil content in the seed and slightly higher seed yield adds up to a considerable increase in oil yield per acre. For the nine tests the oil yield of Golden was 598 pounds per acre compared with 500 pounds for Argentine.

*Good sweet clover silage is safe feed for livestock.*—Use of sweet clover as a forage crop has been on the increase in northeastern Saskatchewan. The crop has become a standard green manure legume with many farmers, and they want to use as forage some high quality crop that is already important in their rotation. In many respects sweet clover has been the answer. It is the highest yielding single-cut legume in the district, but weather conditions are often such that curing it as hay is a problem. Mainly in an effort to circumvent the curing problem a few farmers preserved sweet clover as silage in 1953.

It is well known that sweet clover hay that has been spoiled in the curing process may produce hemorrhagic sweet clover disease in cattle when fed. Whether or not the silage process would give rise to the toxic principle gave the farmers some concern.

The Forage Crops Laboratory, with the aid of the Department of Medical Physiology of the University of Saskatchewan, tested over one hundred animals to determine whether the blood clotting time was increased when cattle were fed sweet clover silage. In two herds being fed sweet clover silage as their only roughage a significant increase in clotting time was found. No increase was detected in another herd also on sweet clover silage. Some of the animals in the affected herds after six weeks of feeding were at the point where they were in danger of hemorrhaging spontaneously. It was found that the rise in blood clotting time was closely related to the proportion of dark-brown silage being consumed. Where cattle had been forced to eat dark-brown silage for several days their clotting time had risen rapidly, whereas the herd feeding on good quality sweet clover silage showed no change in clotting time. More recent unpublished chemical data have shown that there was dicumarol present

in the dark-brown silage but the good green silage from the same silo did not contain this anticoagulant. These findings indicate that sweet clover is a safe silage crop provided methods of preservation are used that will ensure a good quality product.

*The effect of spraying for corn borer control on the yields of field corn.—* Experiments with field corn at the Harrow, Ont., station since 1950 have shown the values of sprays of DDT in increasing yield by reducing corn borer damage. Spray applications at the rate of 1·5 pounds actual DDT per acre were made when 50 egg masses were present per 100 plants; one week later; and two weeks later.

In 1950 an average increase in yield of 8·9 bushels per acre was obtained with two sprayings. In 1951 the single applications gave average increases of 13·9 and 17·1 bushels of corn for first and second dates of spraying, respectively, while two sprayings gave an average increase of 16·6 bushels.

During the years 1952, 1953, and 1954 corn borer infestations were very light and egg mass counts did not exceed 30 per 100 plants. However, a single spray was applied at the peak of egg laying to determine the value of spraying lightly infected corn. Under these conditions little or no increase in yield was obtained from spraying.

Under conditions of moderate to heavy infestation, that is, when the egg mass count reaches 50 or more per 100 plants, spraying for corn borer control is profitable. One spray applied seven to ten days after the egg mass count reaches 50 per 100 plants, proved just as effective in increasing yields as two sprays.

*Time of fertilizer application is important in seed production of Russian wild rye grass.—* An experiment was started at the Lacombe station in 1951 to test the response to fertilizer by Russian wild rye grass grown for seed. Ammonium nitrate at 75 and 150 pounds per acre and ammonium phosphate 16-20 at 150 and 300 pounds per acre were applied at four different times. For the three-year period, 1952-54, summer application of fertilizer gave an average increase in seed yield of 15 per cent more than early fall or early spring applications. Late fall treatments were least effective, resulting in 7 per cent lower seed yield than where the fertilizers were applied either early in the fall or early the following spring. This response to time of application was consistent for all rates and formulations of fertilizer used.

*Creeping red fescue is the most suitable grass for reseeding rangelands in the Alberta foothills.—* On the Stavely Grassland Substation creeping red fescue has given outstanding results as a grass suitable for foothill areas. It produced pasture that is particularly good for fall and winter use, in some cases reducing the need for large hay reserves. It is well adapted to the foothills climate. It has a fine fibrous creeping root that is excellent for soil binding, which is a further advantage in the rolling land so subject to water erosion. It is not a particularly good hay crop.

Other grasses that have shown some promise in these trials include intermediate wheat grass, Alta fescue, and orchard grass. Timothy and brome are both indigenous in the area and most of the cultivated grasses under trial are gradually crowded out by timothy. Timothy is a poor winter grass and the invasion of this species in winter ranges is of some concern.

Alfalfa in mixture with any of the grasses greatly increases the total hay yield. The risk of bloat is all that restricts wide-scale use of alfalfa in pasture mixtures in the foothills area.



## Northern Horticulture

Horticultural investigations on Experimental Farms at such northern stations as Fort Vermilion, Alta., ( $59^{\circ}$  N.L. approx.), Whitehorse, Y.T., ( $60^{\circ}$  N.L. approx.), and Fort Simpson, N.W.T. ( $61^{\circ}$  N.L. approx.), have revealed some interesting results. At Fort Vermilion, almost any vegetable crop can be grown successfully, bush fruits thrive while tree fruits are under study. At Whitehorse, mature heads of late-maturing Penn State Ballhead cabbage have weighed up to 26 lb. each; all cabbage varieties tested matured firm heads from seed sown directly in garden rows. At Fort Simpson, varieties and kinds of vegetables, small fruits, hardy tree fruits, and some ornamentals are being compared for adaptability. General opinion is that inter-play between light intensity and hours of daylight, as well as temperature, has a great effect on yields of hardy crops grown in the far north.

*Upper left:* Good quality cucumber and cauliflower at Fort Vermilion, Alta.

*Upper right:* Sarah Bernhardt peony flourishes at Fort Simpson, N.W.T.

*Middle right:* "Columbia" potatoes grown from seed eyes, Whitehorse, Y.T. Picture below shows cabbage grown on same Experimental Farm; cabbages grown here have weighed as much as 26 pounds each.

*Bottom:* A wide range of vegetables can be grown on the silt soil of the Fort Simpson Experimental Farm—peas, cabbage, cauliflower, early tomatoes, corn and cucumbers to name a few.



# PROGRESS IN SWINE

## The "Lac"

Landrace-Chester foundation boar.



Berkshire foundation sow.



"Lacombe" gilt at 6 months. Note light shoulder and full ham.



Purebred Yorkshire gilt.



Lacombe X Yorkshire sow after first litter.

Seven years of thorough testing and selection have produced a new breed of bacon hogs—a white breed with flop ears, which displays the blood of Landrace, Chester White, and Berkshire.

The foundation of the new breed came from 2 pure Landrace boars, which carried between 47 and 52 pure Landrace sows—all of good bacon quality used since 1952. In 1954 the average conception rate was 55 per cent Landrace, 23 per cent Chester, and 22 per cent Berkshire. Inbreeding has been held to a minimum, thus maintaining vigor.

Selection of breeding stock has been based on advanced Registry carcass score, rate of gain, and litter size.

An analysis of the comparative testing results at the Lacombe Experimental Farm reveals: 1) 100 per cent of the number of pigs born alive per litter, is higher than that of the Landrace; 2) birth weight of the Lacombes is about one-half greater than that of the Landrace; 3) average weaning weight of Lacombes is slightly higher than that of the Landrace; 4) in rate of maturity, Lacombes have a developmental rate similar to that of the Landrace; 5) very similar for the two breeds with a slight advantage to the Landrace; 6) traits of the two breeds appear to be equal or superior; and 7) pigs of the new breed have a longer life span than their mothers.

Additional comparative tests are being conducted by the Indian Head and Scott and co-operative teams to obtain additional evaluation of the Lacombe.

### Performance of Yorkshires, Lacombes and Crossbreds at the Lacombe Experimental Farm, 1954

Breed	No. of Carcasses
York.....	43
Lacombe.....	82
Crossbred.....	103

Animal husbandmen inspecting pigs.



# LINE BREEDING

## "Lacombe" Pig

ction, and a moderate degree of inbreeding at the Experimental Farm, Lacombe, Alberta. Distinguish it from the Yorkshire, and contains Berkshire breeds—but not of the Yorkshire.

isted of 10 Berkshire sows, 5 Landrace—71 per cent Danish Landrace blood, and 19 per cent. No outside breeding stock has been used. The proportion of the foundation breeds was estimated as follows: 75 per cent Berkshire, and 22 per cent Chester White. Present level being about 12 per cent.

sed on performance as measured by Ad-  
economy of feed utilization, and weaned

of the Lacombes and the Yorkshires at the  
er size of the new breed, as measured by  
out the same as the Yorkshire; 2) average  
half pound greater than for Yorkshires;  
one five pounds greater than for Yorkshires;  
ed advantage; 5) average carcass score is  
advantage for the Yorkshire; 6) crossbreds  
to either breed in all important economic  
od temperament, and the sows are good

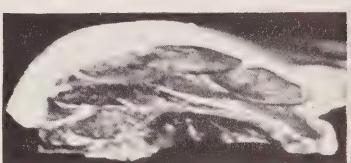
conducted at the Experimental Farms at  
with commercial breeders are in progress  
the breed.

nd Yorkshire X Lacombe Crossbreds

Lacombe, Alta., 1954

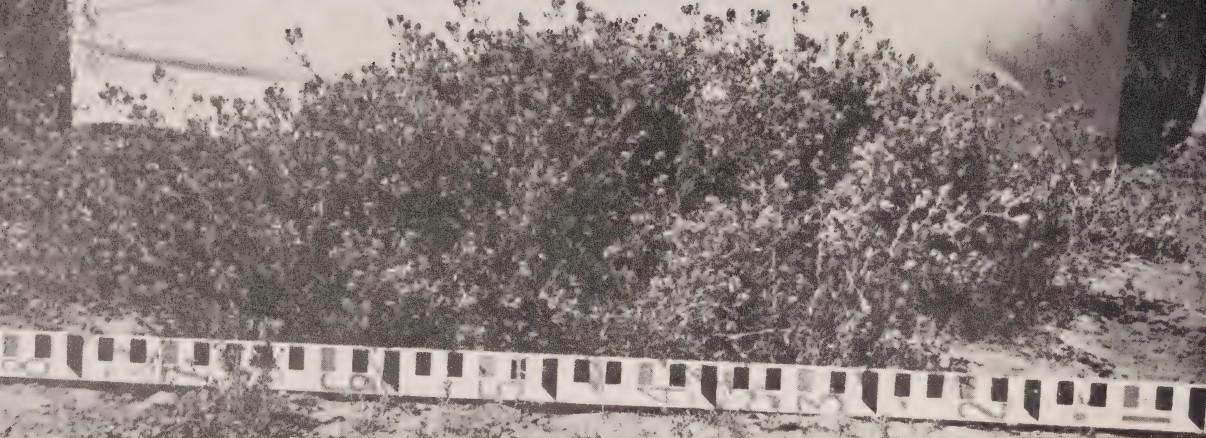
Age at 200 lb.	Per cent A's	Pounds of feed per 100 lb. gain
days		
187	63	378
166	68	380
163	63	365

"Lacombe" gilts on pasture.



*Above:* Carcass and cuts of a "Lacombe" marketed at 157 days, scoring 81 with an "A" grade. *Below:* Interior of test piggery at Lacombe Experimental Farm. Feed consumed by all litter test groups must be recorded accurately as efficiency with which pigs utilize feed is an important economic characteristic.





## PERSISTENCE

### Sought in Prairie Legume

Forage plant breeders have long sought a persistent legume for growing in combination with grasses in the drier prairie areas.

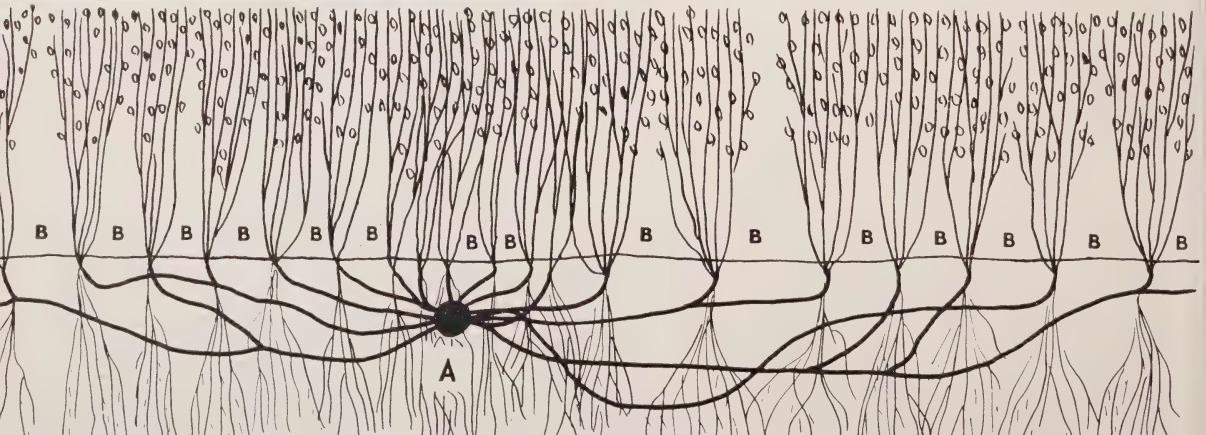
Rambler, a recently-licensed creeping rooted alfalfa variety, developed at the Swift Current Experimental Farm, has shown promise in preliminary tests. It is anticipated that Rambler will fill the need for a suitable hardy, drought-resistant, persistent legume to improve both production and quality of range forage.

*Top:* Single, 2-year-old plant of creeping rooted alfalfa. See sketch below illustrating turf-forming habit.

*Upper middle:* Single, 2-year-old plant of ordinary alfalfa.

*Lower middle:* Breeding nursery showing creeping and non-creeping alfalfa plants.

*Bottom:* Sketch showing details of creeping root system. A: Original crown; B: new plants arising from the creeping root which grow from 4 to 12 inches beneath soil surface. The turf-forming growth habit of Rambler enables the plant to persist even though the original crown may be destroyed by disease or other cause.



*Soil moisture content increased by good range management.*—Grazing trials on the Stavely substation indicate that in addition to vegetative changes and pounds of beef produced, grazing rate has a decided effect on the amount of dead vegetative material remaining at the end of the season. This dead vegetative material is collectively called litter.

Litter is important on the range particularly in the foothills area where the land is rolling and where water erosion could become a serious problem. Litter increases water penetration of the soil by preventing the beating action of rain from sealing the soil surface. Where litter is adequate most rainfall enters the soil and erosion is negligible.

Measurements of the amount of litter remaining on fields at the Stavely substation show that where heavy grazing is practised, the amounts of litter are much less than under light and moderate grazing.

Further studies were made to determine the soil moisture content on each of four fields. Moisture samples were taken at depths of 6, 12, and 18 inches at a number of locations in fields under light, moderate, heavy, and very heavy grazing. At all depths the moisture content was greatest under light grazing and least under very heavy grazing. With heavy grazing which removes most of the protective litter and current vegetation, much of the moisture that falls is lost through runoff and increased evaporation. Erosion is accelerated, with soil loss and gulling the result.

From the standpoint of range plants, the end results are serious. Since less moisture is available for plant growth, drought-resistant native species are favored. These are usually shallow-rooted short-growing grasses, deep-rooted perennial shrubby plants, and rapid-growing annual weeds. They are all of limited forage value and cannot compare with the taller-growing grass species that make up such an important part of good foothills range.

## HORTICULTURE

### FRUITS

*New Fruits*—A new white cherry has been introduced by the Summerland Station under the name Sue. This cherry is of high quality and productiveness, and possesses the unusual characteristic of being practically immune to cracking of the fruit by rain. It is recommended for home garden planting and is also suggested for limited commercial trial by growers who may be interested in a white cherry for canning or processing.

Four recent apple selections from Morden have been given introduction numbers and are now available for wider testing. M-366 is from a Moscow Pear apple seedling crossed with Melba. The tree has shown no external evidence of winter injury after 17 years. The fruits are up to  $2\frac{3}{4}$  inches in diameter and are 70 per cent splashed and streaked bright red. It is a very promising late fall and early winter dessert apple. M-367 arose from a cross between a Tetofsky seedling and Patricia and appears to be quite hardy at Morden. The fruits are not so well colored as M-366, are of about the same size and rate "very good" as dessert apples. The season is mid-September to early December. M-368 was selected from a cross of Trail and McIntosh. The tree appears hardy and productive. The fruits are small in size, 2 to  $2\frac{1}{2}$  inches in diameter, and are more highly colored than Trail. It is rated "excellent" as a dessert sort and "fair" when cooked. The season is early October to the end of December. M-369, an open pollinated seedling of Anism, has been hardy and productive. The medium to large fruits are highly colored with bright dark red, and are rated "very good" as dessert and "excellent" when cooked as sauce. The season is fall and early winter.

During the past two years an early apple seedling has shown considerable promise at Ottawa. O-342, a seedling of Crimson Beauty  $\times$  Melba parentage, ripens at approximately the same time as Crimson Beauty but is greatly superior in quality. It is a round conic apple and has fairly good appearance. In 1954, T-441 from a Crimson Beauty  $\times$  Red Melba (Pate strain) was selected. T441 is an apple of Crimson Beauty season, has excellent appearance and good quality, and appears very promising.

*Chemical Thinning of Tree Fruits*—The thinning of apples at blossom time or shortly afterward is now becoming standard practice in the various fruit growing areas of the country. Over the past few years many different chemicals have been tested at those stations where orchard work is important. Results have not been consistent either between stations or from year to year. Seasonal variations evidently play a great role in chemical thinning results. The influence of chemical thinning on biennial bearing of McIntosh and Fameuse varieties has been demonstrated at Kentville where one-half of a four-acre orchard was given a thinning spray of naphthaleneacetic acid in 1953. In 1954 the unthinned section had only 29 per cent of full bloom while bloom on the thinned area was 87 per cent. The average respective yields of McIntosh were 237 and 659 pounds of fruit per tree from the two areas. Similar effects were recorded with the Fameuse trees.

At Summerland, a spray of DN 289 at a strength of 10 pints per acre applied shortly before full bloom has shown considerable promise in thinning peaches. If the time of application was delayed until full bloom or slightly after, the thinning effect was greatly reduced. Some success was obtained at Harrow using Chloro 1.P.C. formulations as a post-bloom spray applied three to four weeks after full bloom. The results varied considerably with different varieties. Maleic hydrazide applied either at full bloom or shuck fall to peach trees has not proved successful to date as a thinning agent at Harrow.

*Promising Strawberry Seedlings*.—Agassiz seedling No. 53, a selection from the cross Pathfinder  $\times$  British Sovereign, has shown considerable promise in grower tests. Yields have been higher than those of British Sovereign, the fruits being large, firm, and uniform in size throughout the picking season. Berries are a bright red, both externally and internally, with a slightly acid flavor, and have high freezing quality. The plant is vigorous and productive. It appears to have some resistance to drought and to the red-stele disease.

Two Fredericton seedlings, F 487 and F 489, seem to have particular promise. F 847, from a cross of Sparkle  $\times$  Valentine, ripens slightly later than Senator Dunlap. The fruit is bright and attractive and of medium to large size throughout the season with firm flesh and good quality. Up to date the plants have been free from leafspot. F 489, from the reciprocal cross yields slightly less than F 487 but is earlier ripening. The fruit is medium in size, holds up well throughout the season and is firm and well flavored. The plants are more squat in habit and have been free from leafspot to date.

#### VEGETABLES

*New Early Tomato Variety*.—A tomato variety originated at the Harrow station has been released under the name Harrow. Its main advantage is that the fruits are more resistant to cracking than most other varieties. The fruits are somewhat smaller than many varieties, averaging between four and five per pound. Although Harrow is a determinate variety, it has yielded well in staking tests in the past two years.

*Garden Pea Varieties for the Prairies.*—For the past three years, a co-operative trial of six varieties of garden peas has been carried on at eight Prairie Experimental Stations. The variety Selkirk which is an origination from this Division has shown up favorably in comparison with Lincoln, the popular variety in these areas. Results from these trials have shown that the pea variety Selkirk has very good regional adaptability, and was earlier than Lincoln at all locations. It is expected that Selkirk will prove at least a complementary variety to Lincoln for a large part of the Prairies. Director has also shown good promise with much the same yielding ability. Ottawa PE-1, another origination of this Division, shows good yielding ability and is late maturing thus extending the season of production. Vine growth of this variety is tall which makes it undesirable in areas where wind damage may occur.

*Weed Control in Vegetable Crops.*—Of five chemicals tested for peas at Charlottetown the best weed control was found with Sinox P.E. and good pea yields were obtained. At Harrow good control of weeds was obtained in melons with Alanap 1, sprayed two days before planting at a rate of five pounds per acre, followed by two later applications at two-week intervals. No harm was done to the melons and weeds were kept under control for the rest of the season. Good control was also obtained in cucumbers with Alanap 1 and no damage resulted to the young cucumber plants under waxed paper. Pre-emergence spray of Alanap 1 at one and two pounds in 50 gallons of water per acre did not give satisfactory control of weeds in squash and cucumber at Ottawa. Applications at four and six pounds per acre showed better weed control but crop varietal reaction was variable. In tests of several chemicals for the control of grasses in potatoes at Agassiz, Dalapon proved most promising as a pre-emergence application. At 15 pounds per acre, 98 per cent control of all grasses including couch grass was obtained. Yields of potatoes in all Dalapon-treated plots gave significant increases over the unweeded check.

*Spacing of Canning Crop Tomatoes.*—Results from tomato spacing trials at Smithfield indicate that with some of the newer bush varieties being tried by the canning industry spacings could be much closer than those now in general use. In these trials the variety Ottawa TO-17, which is a vigorous bush type, was grown at five different spacings in 1953 and 1954. In both years the heaviest yields of canning grade tomatoes per acre were from the 3 by 3 feet spacing, while the lowest acreage yields were from the 6 by 3 feet spacing which is commonly used in commercial plantings in this area. In spacing trials at Summerland highest acreage yields were obtained when an area of 16 square feet was allowed per plant. The variety Clarks Early, a medium vigorous type, was used in this trial at six spacings ranging from 8 to 24 square feet per plant.

*New Hybrid Cucumbers.*—Two new Morden cucumber varieties are ready for introduction. Morcrop Hybrid, an F<sub>1</sub> hybrid from a Mincu × New Cubit cross, has demonstrated good yielding ability and is satisfactory both as a pickling and as a slicing type. Morden Early is the earliest variety grown at Morden, being six days earlier than Early Siberian. This variety appears to be most suitable for northern gardens.

#### ORNAMENTALS

*New Ornamentals.*—Morden Almond, a seedling of Prairie Almond × a numbered reciprocal sister, has been introduced by the Morden station. The flowers are double, slightly smaller than those of *Prunus triloba* fl. pl. but of a deeper pink color and apparently longer lasting. The nuts are coppery pink in color, adding to the attractiveness of the plant which is dwarfish and fine in branchlet, stem and leaf.

*Timing of Greenhouse Carnations.*—By direct planting of cuttings from propagation and single pinching, it has been possible to bring carnations into bloom within a controllable range of time at Ottawa. However, seasonal variation and varieties play a large role in any timing program. A tentative scheme for predicting peak production has been worked out for vigorous, free breaking varieties such as Apollo. This scheme is based on the number of hours of sunlight available during different months of the year. The maximum hours of sunlight are found in the month of July, and all other months are reduced to "equivalent July days". Thus, January, which has but one-third of the sunlight available in July is said to have 10 July equivalent days.

*Lily Propagation.*—In the propagation of lilies at Ottawa considerable advantage has resulted from the use of an incubator in which temperature and humidity can be controlled.

*Heat Curing of Wedgewood Iris.*—In order to determine the value of the heat curing treatment on British Columbia grown iris, tests were carried out at Saanichton with four different storage treatments after the bulbs were dug. Curing the bulbs at a temperature of 90°F. for ten days, followed by normal shed storage, resulted in an increase of 20 per cent over shed stored bulbs. The production of grade one flowers was increased by 56 per cent. Chilling of cured bulbs produced the earliest flowers, the first being cut on December 11 from lots benched on September 20. On the average chilling of cured bulbs resulted in flowering 15 days earlier but there was a reduction of 26 per cent in the number of marketable flowers.

#### PLANT NUTRITION

*Trace Element Requirements.*—During the past few years work at Ottawa with trace elements has been aimed towards the establishment of critical levels in plant tissue related to optimum yield and quality. Such levels have been established for boron, magnesium and manganese on a number of crops. As well as continuing studies on these elements in plant tissue considerable attention has been given to deficiencies of zinc, molybdenum, and copper. The need for a method for determining the trace element requirement of different soil areas and for specific crops has led to the use of the fungus *Aspergillus niger* for this purpose. The use of chemical methods has not proved too satisfactory and it is felt that a lower species of plant organism should be a better index of availability of micronutrients to plants than any chemical extracting solution, and consequently should form a better basis for fertilizer recommendations for these elements.

A special laboratory has been established to use *A. niger* as a test organism to determine copper, zinc, and molybdenum. Standard curves have now been established for these elements in plant tissue and soils. Results by this method have shown close agreement with chemical procedures, and the bio-assay technique has been adopted exclusively for certain micro-element determinations at this Division.

*Nutrient Content of British Columbia Apple Trees.*—At Summerland a survey of the nutrient content of leaves has been under way since 1952. It is proposed to continue this survey until the whole British Columbia interior fruit growing area has been covered. So far, the data cover the area from Osoyoos to Westbank. Leaves from trees grown on clay soils were markedly higher in phosphorus and magnesium than the average content while leaves

from rubble soils were markedly lower. Potassium was as high on rubble, the poorest soil type, as on any other soil type. Some varietal differences were also apparent. Newtown was low in magnesium as might be expected from its susceptibility to leaf blotch. Winesap and Delicious leaves appeared to be generally higher in nutrients than McIntosh and Newtown. The distribution of magnesium content showed a wide range of values, many orchards being below the generally accepted critical range of 0·20 to 0·25 per cent magnesium. The potassium distribution was entirely above the critical level of 1·0 per cent where deficiency symptoms appear. Phosphorus levels in all orchards appeared to be adequate. The nitrogen distribution showed that in general nitrogen levels were slightly too high for the production of large crops of high quality fruit.

*Irrigation of Vegetables on Sandy Soils.*—Experiments at Kentville with sweet corn on Cornwallis sand showed that irrigation increased the efficient utilization of applied fertilizers. An addition of two tons per acre of 6-12-6 fertilizer to irrigated plots gave an increase in yield of approximately 50 per cent over that obtained from a one-ton application, while corresponding treatments on the unwatered plots resulted in only 25 per cent yield increases. A more complete filling of both ears and kernels was observed in the crop from watered plots, with the better treatments producing yields of more than 1,500 dozen ears per acre.

#### FRUIT AND VEGETABLE PROCESSING

*Canned Fruit Pie Fillings.*—Investigations are being conducted at Summerland on a canned product of approximately 80 per cent fruit and 20 per cent sugar, with stabilizers varying from 1 to 3 per cent. This is a higher fruit content than practically any other canned fruit product. Small commercial packs of several fillings have been tested on the market with indications of a ready acceptance of this type of product. Stabilizers, usually employed in some combination, which have proved to be most satisfactory, are as follows: pregelatinized tapioca, normal granulation down to less than 40 mesh; waxy maize stabilizer; fruit pie filling starch; locust bean gum. Satisfactory formulae have been developed for most British Columbia fruits. An acceptable sour cherry filling was made with a combination of stabilizers consisting of locust bean gum, waxy maize, and minute tapioca or phosphorylated starch. Formulae have been developed for the following berries: strawberry, raspberry, loganberry, blueberry, blackberry, and black currant. With each of these fruits except strawberry, apples were used, resulting in improved texture and stability. The proportion of apple to berry varied with the different fruits. In storage at higher temperatures there was a marked variability between products in color and flavor. Those fillings apparently least affected by high storage temperatures (up to 100° F.) were apple, peach, and apricot. Black currant was fairly resistant, while the other fillings fell between the two extremes.

*Processing Dry Beans.*—It has been found at Lethbridge that most of the better pea-bean varieties can be grown successfully in southern Alberta and that they process well. Tests were made to determine the best method of processing beans that were over-dried in storage, a serious local condition due to natural low humidity conditions. A one-minute pre-soak boil tenderized the outer tissue sufficiently to allow a 10- to 12-hour soaking period to reconstitute the beans, for bean with pork packs. Organoleptic and physical tests indicated that the varieties Michilite and Ontario were generally preferred. The Lethbridge selection of Burbank had unexcelled flavor but was slightly large for the present demand of the trade. The varieties Robust, Strider, and Great Northern were considered to be too large for beans with pork.

*Acidity of Rhubarb.*—Considerable varietal differences in acid content of six varieties of rhubarb have been found at Morden for the past three years. Sutton's Seedless was consistently higher (1·57 to 2·23 per cent) with Valentine intermediate (1·39 to 1·73 per cent). Canada Red, Early Sunrise, Plum Hutt, and Ruby had acid contents of 1·26 to 1·71 per cent. Marked seasonal differences in mean acid content from one year to another were evident and this appeared to be inversely associated with the amount of rainfall during the harvest period. Mean acid content for the three years was 1·78, 1·60, and 1·32 per cent while the rainfall was 1·75, 4·50, and 7·50 inches, respectively, indicating that lower acid content resulted from higher rainfall and consequent higher soil moisture levels. During normal precipitation there was a tendency toward increased acid content with advancing date of harvest. Precipitation higher than average, however, nullified this trend and reduced acid values to a lower level.

#### FRUIT AND VEGETABLE STORAGE

*Storage of McIntosh Apples at Two Degrees of Frost.*—Tests have been conducted at Ottawa to assess the relative merits of storing McIntosh apples at 30° F. instead of the normally accepted 32° F. This is now feasible because of the availability of more reliable and more closely controlled refrigeration equipment. It was found that both fungal and physiological wastage were reduced at the lower temperature. This effect, however, was not always substantial. The effect upon coreflush development was largely a delaying action, the time of coreflush onset being initially postponed but accelerated later in long storage and tended to reach the same level as occurred at higher temperatures. The period of flavor acceptability of fruit stored at 30° F. was increased by 20 per cent over McIntosh stored at 32° F. and substantially more when compared with fruit stored at higher temperatures. Considerable improvement in firmness and juiciness was observed with fruits stored at the lower temperature. This was in particular evidence during the first three months of storage. In the later stages of storage these tended to decline to approximately the same levels as fruit stored at higher temperatures.

*Polyethylene Bags for Pear Storage.*—The use of polyethylene bags for storing pears appears to show considerable promise. In tests at Summerland, Bartlett pears of fairly advanced maturity were packed and stored in polyethylene bags in standard boxes. Pears packed in bags were of much better appearance on removal from storage than those in standard boxes, and showed considerably greater longevity at 70° F. In general, the pears held in the polyethylene bags lasted about 10 days before core breakdown set in, whereas similar untreated fruit had started to show breakdown within five days after removal from storage. Pears held in polyethylene bags had a satisfactory storage period of three months as compared with slightly over two months for the untreated fruit. Little difference in keeping quality was found between pears stored in bags of two different thicknesses—1·5 and 2·0 thousandths of an inch. The relative concentrations of carbon dioxide and oxygen were markedly influenced by the thickness of the bag. Where the bag had a thickness of 1·5 thousandths of an inch, the carbon dioxide built up to approximately 6 per cent and the oxygen was reduced to 7 per cent at a holding temperature of 32° F. In bags with a thickness of 2·0 thousandths of an inch some very low oxygen concentrations were found, running as low as 0·8 per cent, but in general averaged about 3 per cent. The carbon dioxide concentration in these bags varied from 9 to 13 per cent.

*Mold Control on Strawberries.*—At Ottawa tests with trichloroethylene vapor have been carried on to reduce mold growth on strawberries and thus increase the shelf life. It was found that when fruits were treated at the rate of one volume of liquid trichloroethylene to 20,000 volumes of free air space every two days under non-cumulative conditions at 71° F. the mold-free period was increased 33 per cent. The same treatment carried out at 40° F. more than doubled the mold-free period. In sealed containers previously charged with one volume of liquid trichloroethylene to 20,000 volumes of free air space, the shelf life of the fruit stored at 71° and 40° F. was doubled.

### ILLUSTRATION STATIONS DIVISION

The experimental program on Illustration Stations and District Experiment Substations is designed to provide information on the nature and variability of farm problems in Canada and the measures that must be taken to provide an adequate solution for them. The 234 Illustration Stations and District Experiment Substations in Canada, associated with the centrally located Experimental Farms and Stations, represent an expansion of the area of experimentation and research under conditions of commercial production. These station farms are so located that they represent areas and soils not covered by the Experimental Farms and Stations.

*Fertilizer Formulae that Give Optimum Potato Yields Vary Between Production Areas.*—Detailed fertilizer formulae studies have been conducted within crop rotations on the New London, P.E.I.; St. Quentin and East Centerville, N.B.; Luceville, Que.; and Fort William and Kenora, Ont., Illustration Stations, during the past eight years. At New London it was found that increased levels of nitrogen and potash had a marked effect in increasing yield while phosphate had none in the initial applications. When repeat applications were made in the second rotation cycle, positive yield increases were derived from higher levels of phosphorus. At St. Quentin no significant difference was found between the yields from the formulae tested at the rate of 1,500 pounds per acre as a supplement to manure. The levels studied were 3, 6, and 9 per cent nitrogen; 8, 12, and 16 per cent  $P_2O_5$  (phosphate); and 5, 10, and 15 per cent  $K_2O$  (potash) in all possible combinations. At East Centerville the intermediate levels of N,  $P_2O_5$  and  $K_2O$  as represented by 4-8-5 and 4-8-10, gave significant yield increases over other formula combinations when applied at 2,000 pounds per acre as a supplement to manure. At Luceville, the response to increasing levels of the various nutrients was not pronounced. However there was an evident response to increased levels of nitrogen. Phosphorus gave yield increases at the intermediate and high levels in the initial applications and at the intermediate levels only in the repeat applications. There was no response to increased levels of potash in the initial applications, but slight responses in the second cycle of the rotation. At Fort William, increased levels of nitrogen and potash did not benefit the crop, but at Kenora there was marked yield increase from raising the level of both of these nutrients. Increased phosphorus levels gave large yield responses at both locations as also did manure. At Fort William the yield with manure and fertilizers was 364.4 bushels per acre as compared with 329.3 bushels per acre with fertilizers alone. At Kenora the yield was 370.6 bushels per acre with fertilizers alone and 454.3 bushels with manure and fertilizers. These studies reveal that with the usual high rates of application of chemical fertilizers for potato production considerable economy can be effected by due regard to the selection of formulae for the area concerned and the judicious use of manure.

*Among the Gray Wooded Soils Fertility Requirements Differ.*—The individual characteristics of various soil series within the Gray Wooded soils are clearly shown by variable crop response to specific fertilizer treatments studied on the Gray Soil Substations and Illustration Stations. The gray soils at Chedderville, Alta., respond to sulphur. Results of a fertilizer formula study conducted within a five-year grain-hay rotation during the past four years reveal that applied nitrogen and phosphorus play an important role in wheat production at McLennan, Alta., with high levels of nitrogen being more important than high levels of phosphorus. Potash has given no appreciable increase in the yield of wheat at McLennan. At Loon Lake, Sask., sulphur is markedly deficient and applications of gypsum have given slight wheat yield increase, and increased the yield of legume hay from less than one-third to over three tons per acre. On Garrick soils at Snowden, Sask., nitrogen, phosphorus, and potash all have had a positive effect on the yield of wheat but there has been, as yet, no apparent effect of sulphur on the yield of either wheat or hay. The soil at Athabasca, Alta., is most variable and no specific results have been obtained to date. Studies are continuing with a view to being able to supply specific information for the improvement of crop production on these Gray Wooded soils as they are identified and brought under cultivation.

*The Effect of 2,4-D and M.C.P. on the Yield of Cereals Depends on the Condition of the Crop Treated.*—The effect of applying 2,4-D at various rates to wheat crops in the proper stage of growth has been studied for four years on four District Experiment Substations in the Scott, Sask., Supervisory District. Two-, four-, six-, and eight-ounce rates of the amine and ester formulations were tested. Yields procured indicate that the amine formulation had no adverse effect even at the 8-ounce rate. However, the ester formulations had an adverse effect at the 8-ounce rate and there was some loss of crop vigor and a percentage of misshapen heads at the 6-ounce rate. There were very definite indications in these studies that crop response to spray applications is directly dependent on the degree of weed infestation and the control achieved. The spraying of weed-free cereal crops has no marked beneficial effect on yields and may have a pronounced deleterious effect at heavy rates of application. An 8-ounce application of low volatile ester on a wheat crop slightly infested with weeds reduced the yield from 50·6 to 44·2 bushels per acre at Pincher Creek, Alta., in 1952. However, the spraying of weed-infested crops with the resultant decrease in competition for nutrients, moisture, and other factors, can provide for greatly increased yields. As an extreme example of this effect the results obtained at Paddockwood, Sask., in 1950, show that in an oat crop heavily infested with perennial sow thistle it was impossible to measure any yield on the unsprayed plots, yet on those sprayed with 6 ounces of the ester formulation a yield of 25·0 bushels per acre was recorded.

*Progress Being Made in the Control of Toadflax at Marsden, Sask.*—Cultural control of toadflax was expanded in 1954 to include the study of cropping systems, after-harvest tillage methods, methods of preparing fallow, and the period of fallow required for complete eradication. Black or intensively tilled fallow alternated with a grain crop has reduced the weed infestation to a point where it does not interfere with grain production. In 1954 the use of the plow for initial spring tillage reduced the number of fallow operations by nearly 50 per cent as compared with the "oneway" for the first treatment. CMU at 80 and 100 pounds per acre has given complete soil sterility for more than a three-year period. Ester 2,4-D at rates up to 40 pounds per acre has

only given temporary top growth control. Alternate tillage and spraying with 2,4-D resulted in a reduced number of fallow operations particularly after plowing. Light applications of sodium chlorate, polyborchlorate, and CMU following tillage resulted in complete top growth control from mid-August until freeze-up.

*The Chemical IPC Controls Volunteer Rye Grass in Red Clover for Seed Production in the Fraser Valley of B.C.*—Experiments conducted at Cloverdale, B.C., have shown that volunteer rye grass (*Lolium multiflorum*) in double-cut red clover may be effectively controlled with IPC (Isopropyl-N-Phenylcarbamate). Substantially increased yields of red clover seed can accrue from this control of rye grass through the use of IPC at the rate of 6 pounds of acid equivalent per acre applied either in the spring or fall. The two-year average yield of seed on the untreated area was 334 pounds per acre while a yield of 487 pounds was recorded on the area treated with 6 pounds of chemical in the spring. Fall applications gave two years freedom from the rye grass while the spring applications did not.

*The Effect of 2,4-D on the Stand of Newly Seeded Legumes has been Studied in the Manitoulin Island District.*—During the period 1950 to 1954 tests were laid down on four stations in the Mindemoya, Ont., Supervisory District to determine the effect of spraying cereal nurse crops for weed control on newly seeded alfalfa and red clover. The effect of a 4-ounce-per-acre application of the butyl ester formulation ranged from no reduction to a 40 per cent reduction in legume stand. The 8-ounce application caused from 10 to 50 per cent reduction in the fall stand of legume while the 16-ounce rate caused up to 80 per cent decrease in legume stand. It was found, however, that the legume population gradually recovered as did the population of such pernicious weeds as perennial sow thistle. The weeds showed greatest recovery the year after spraying while legume recovery was apparent following the second year after seeding. Where the spray application was not sufficiently heavy to seriously reduce the legume stand there was a satisfactory net decrease in the weed population.

*Crop Varieties and Seeding Mixtures Widely Studied.*—Varieties of cereal, forage, and other crops are under study on stations that represent wide variations in soil and climatic conditions. Cereal varieties were studied on 166 stations in 1954, grain corn varieties on 27, silage corn varieties on 10, root varieties on 7, and potato varieties on 16 station farms. Introductory forage crop nurseries, in which the adaptation of various species and varieties of grasses and legumes to local climatic and soil conditions is studied, were established on 81 stations in 1954. Hay mixture studies were conducted on 130 farms and the results obtained during nine and six crop years on the District Experiment Substations at Mindemoya and Fort William, respectively, might be taken as indicative of the necessity for such tests. At Mindemoya, seedlings of alfalfa alone and alfalfa-grass mixtures provided the best over-all hay yields. At Fort William alfalfa alone provided relatively poor yields and the best yields were obtained from mixtures containing red clover and timothy.

*Fertilizer Applications to Wheat Profitable in all Soil Zones of the Prairies.*—An analysis of fertilizer tests conducted on Illustration Stations in the Prairie Provinces during the three-year period 1951-53, indicates that it is profitable to apply fertilizers to wheat on fallow at the recommended rates, and, in certain zones, heavier rates than are currently recommended would have been profitable.

The fertilizer formulae tested were 11-48-0 applied at 20, 40, and 60 pounds and 16-20-0 applied at 48 and 96 pounds per acre. Prices used as measures were the average farm price of wheat and retail cost of the fertilizer in each province during this period.

In the Brown soil zone, 11-48-0 applied at 40 pounds per acre was the most economic rate of application. Application of 16-20-0 was unprofitable at both rates tested. In the Dark Brown soil zone, both 11-48-0 applied at 40 pounds and 16-20-0 applied at 96 pounds were the most feasible rates. In the Black soil zone, the most economic rate of application of 11-48-0 was between 40 and 60 pounds per acre. Using the formula 16-20-0, the 96-pound rate was more profitable than the 48-pound rate but total net returns per acre were less than when using the 40- to 60-pound rates of 11-48-0. In the Gray-Black transitional soil zone, indications are that up to 80 pounds of 11-48-0 or over 96 pounds of 16-20-0 would have given maximum returns. In the Gray-Wooded soil zone, the additional revenue from the application of 11-48-0 fell off sharply between 40 pounds and 60 pounds with the possibility that some rate in between was the most profitable. Application of 16-20-0 at 96 pounds and the 40-pound rate of 11-48-0 were equally profitable, and indications are that some rate in excess of 96 pounds of 16-20-0 could have been applied to advantage.

*Farm Business Records Yield Comparisons of Farm Efficiency on Illustration Stations.*—Farm business data collected during the five years 1948 to 1952 illustrate the regional differences in size of business and intensity of operations found in agriculture in Eastern Canada and British Columbia as compared with the Prairie Provinces. In making this comparison, the records of 158 stations were used for which data for 5 years were available.

The net returns to the capital, labor and management for the prairie stations were \$3,900 per farm and for the Eastern Canada and British Columbia stations \$2,100 per farm. Average man-equivalents per farm were 1.8 for the prairie stations and 2.2 for the station farms in Eastern Canada and British Columbia. These two measures are commonly used to evaluate "scale" or "size of business".

Agricultural operations are much more highly intensified on the Eastern Canada and British Columbia stations than on the prairie stations. Capital investment per acre of crop land amounted to \$199 per acre in the East and British Columbia as compared with \$45 per acre in the prairie region. This is over four times greater for the former areas. Gross receipts per cropland acre were respectively, \$71 and \$14, a ratio of five to one. Acres of cropland per man-equivalent on stations in Eastern Canada and British Columbia averaged 33 acres as compared with 400 acres for the prairies. Thus, acres of cropland per man on the prairies were over nine times greater. However, it should be noted that the "acres of cropland" includes fallow land which constitutes a large proportion of the cropland acreage in the prairies but is relatively unimportant in the other areas.

In terms of "over-all efficiency", total revenue per dollar of cash expenses (including capital expenditures) was \$1.47 for Eastern Canada and British Columbia as compared with \$1.63 for the prairie stations.

*Many Farmers Attend Illustration Station Field Days.*—During 1954, 156 field days were held on Illustration Stations and District Experiment Sub-stations across Canada. Total attendance was 11,764 or an average of 75 people per meeting. At these events an opportunity is provided for farmers in the

area to view the experimental work under way and to bring their problems to the attention of the Experimental Farms Service officials who take part in the program. In addition to holding regular field days, officers of the Division were called upon in 1954 to address 83 farmers' meetings held by Agricultural Societies and Crop Improvement Associations.

## POULTRY DIVISION

### GENETICS

*A strain with a wide genetic base responds to selection.*—A strain, formed in 1950 from the mating of 7 strains of White Leghorns in all possible directions, and which has been under intensive selection for high henhouse egg production since that time, has responded markedly to this selection. After correcting for environmental changes, the gain in two generations has been 18 eggs per bird housed. Since there were more than 2,000 birds housed each year, this gain is highly significant. Less progress has been made in another strain with a narrower genetic base but a higher average production, which is also under selection for increased egg production. In three generations, the increase has amounted to only 10 eggs and most of this increase occurred in the first generation.

*Control strain of White Leghorns.*—In 1950 a control strain of S.C. White Leghorns was formed to serve as a control on breeding projects concerned with egg production. Data gathered over the past four generations indicate that there is very little genetic change in the population from year to year. By reference to the performance of the control strain, corrections can be made for uncontrollable environmental fluctuations caused by climatic, dietary, and management changes.

This control strain has been and is currently being used in the New York Random Sample Tests at Cornell University as a control on environmental fluctuations between their two tests and among years. This control strain will be used in all breeding projects involving the study of egg production and related characteristics.

*Continued progress made in selecting for egg production in geese.*—For the fourth consecutive generation, the average egg production of a superior strain of Pilgrim geese has been raised. One hundred and ten yearling geese averaged 26 eggs during the 1954 season. The range in egg production was from a low of zero to a high of 51 eggs. This increase in egg production was obtained without any decrease in fertility or hatchability, both characteristics remaining at a high level. By improving rearing and management procedures, rearing mortality (0 to 16 weeks of age) has been cut to 2 per cent in the latest year for a flock of over 700 geese.

*Effect of age on the reproductive ability of geese.*—Contrary to the well-established fact that chickens lay fewer eggs in their second and third laying years than in their first year, geese have been shown to lay progressively more eggs each year up to at least their fourth year of age. This factor combined with the very low mortality rate for adult stock should make it possible to produce goslings at a lower cost from stock two years old and older. Since two-year-old and older geese lay considerably larger eggs than do pullet geese, and since the goslings from these large eggs are generally more vigorous, a large proportion of the goose breeder's flock should consist of geese two years old and older.

Some data have been obtained which show that yearling geese produce eggs that do not hatch so well as the eggs from older females, and this also increases the cost of producing goslings from yearling breeders as compared with older birds.

*Geese can survive low temperatures without cover.*—A flock of 100 geese survived several weeks' severe winter weather with no protection. During this period, the temperature dropped below zero several nights and as low as 20 below zero. Despite the fact that there was no mortality, the geese were very uncomfortable during the severe weather and it is recommended that protection from wind and snow be provided along with dry litter. It is not necessary to provide insulated or heated houses. It is easier for the geese to keep comfortable and to move about during cold weather to feed and water if they have dry litter to walk on.

*Instruments tested for evaluating breast conformation in meat birds.*—Several instruments for measuring breast conformation in broilers, some of which were designed by the staff of the Poultry Division, have been tested for repeatability, and differences in the accuracy of these instruments were observed. There were also very large differences in the time required and the convenience of use of the different instruments for measuring breast width in broiler birds.

*Hybrid vigor for egg production obtained in a cross of two meat-type strains.*—By crossing a male line developed for meat production on meat-type females, a cross-bred has been produced that consistently lays more eggs than either parent breed. Such cross-bred females mated to another distinct breed of dominant white males may be one way around the problem of low egg production in hatchery supply flocks furnishing chicks to the broiler trade. This problem is being investigated further.

*Forced molting procedure found successful.*—White Leghorn flocks at Harrow and Lethbridge have been successfully force-molted at the end of a 500-day test period and returned to the laying house after two months for a second year. Under certain market conditions, and with certain strains, this procedure may be preferable to using an all-pullet flock each year.

*Not all meat strains can be crossed with advantage.*—Extensive tests over the past three years at Fredericton have shown that only a small proportion of the meat breed strains of fowl tested crossed with any advantage. Before two strains are crossed for the production of commercial broiler chicks, extensive tests are to be recommended.

*Good turkey broilers obtained from the Empire White breed.*—Empire White turkeys, which are in the weight range of Broad Breasted Bronze, and which are relatively unselected for early growth, make satisfactory broilers at twelve weeks of age. The average dressed weight for both sexes was 7·0 lb. and the eviscerated weight was 5·3 lb. or 75 per cent of the dressed weight. These turkeys had attractive conformation but very little fat at this age.

A preliminary trial with estrogens resulted in better finish (fat deposition) and significantly fewer pinfeathers. White-feathered strains of turkeys are nearly mandatory for the production of attractive turkey broilers.

## NUTRITION

*Twenty-two per cent protein is adequate in ration for broilers to seven weeks.*—A practical broiler ration containing 22 per cent protein has been found adequate for optimum weight and feed efficiency to seven weeks of age followed by a finishing ration of 18 per cent protein. Protein levels beyond 22 per cent were not economical, while less than 22 per cent caused a reduction in weight if fed during the first seven-week period.

*Pelleting broiler rations increases feed consumption, feed efficiency and body weight.*—A series of feeding trials was conducted to determine the value of pelleting various types of broiler rations. In all cases an improvement in weight, utilization of feed, and carcass grading was noted. However, the birds were more disposed to feather pulling and cannibalism when fed the pelleted ration. The disposition to these vices was effectively countered by debeaking the chicks at two weeks of age. The benefits from pelleting the ration more than offset the cost of the pelleting.

*Growth promotants not recommended for goslings.*—A series of tests was conducted at Ottawa to determine the value of several antibiotics and an arsenical compound in a gosling ration. A significant growth response to aureomycin and penicillin was noted to two weeks of age, but beyond this no benefit was evident from the antibiotics. On the other hand the arsenic compound was ineffective in stimulating growth and in one experiment, tended to decrease gosling weights. The efficiency of feed utilization was improved with 100 p.p.m. of aureomycin, but this improvement was not sufficient to warrant the use of the antibiotic.

*Calcium and phosphorus requirements for goslings under study.*—Results of two experiments designed to determine the calcium and phosphorus requirements of goslings indicate that 0·2 per cent inorganic phosphorus and 0·4 per cent calcium in the ration fed supported optimum weight gains and bone ash percentages to five weeks of age. These findings are rather surprising in view of the greater growth rate of goslings as compared with chickens and turkeys, and the higher requirements for calcium and phosphorus of these latter species. Further work is contemplated on this subject.

*Correct proportions of protein and energy in laying mash are important.*—The protein and energy requirements of laying hens and the inter-relationships between these two components of the laying mash were studied at Ottawa. On a survivor basis, egg production was improved with increased protein from 15 to 17 per cent, and when the energy content of the ration was increased from 755 to 925 calories per pound. Statistical analysis revealed a significant interaction between protein and energy. These results indicate the need for increased protein in a ration containing a large proportion of high calorie grains such as wheat and corn.

*Goslings require salt and manganese for optimum weight and efficiency of feed utilization.*—Goslings raised to five weeks of age responded to added salt ( $\text{NaCl}$ ) and manganese ( $\text{MnSO}_4$ ) in their rations. Optimum weights and feed efficiency were obtained with 0·25 per cent added salt and 50 parts per million of manganese. These results are interesting in view of the lack of information regarding the mineral requirements of goslings.

*Studies on the use of barley in broiler rations continue.*—Experiments have been conducted at Ottawa this year with the use of barley in broiler rations. The results to date indicate decreased growth and finish with rations containing barley. Pelleting the rations improves weight and finish. Further work is being done in the attempt to devise a feeding system to utilize more barley in broiler rations.

*Restricted feeding program for replacement stock being tested.*—At Nappan, N.S., and Brandon, Man., last season half of the replacement stock were restricted to approximately 75 per cent of the feed consumption of full-fed birds. The full-fed and the restricted groups are now in the laying pens, receiving rations of different protein and energy levels. The effect of restricting feed during the rearing period on subsequent performance in the laying pens will be determined, and possible interactions between rearing treatments and laying house treatments will be checked.

*Wet mash feeding.*—The effect of offering a feeding of wet mash to laying hens once a day was tested at Brandon, Man. It was found that feeding wet mash increased feed consumption and egg production for several months, but over the year as a whole it had no effect.

*Fish meals being evaluated in the Maritimes.*—The protein quality of fish meals manufactured in the Maritime Provinces is being studied at Nappan, N.S. The object is to obtain some information on the variation in quality between different samples of fish meal.

*Method of rearing turkeys.*—Investigations are continuing at Swift Current, Sask., on the discovery of more convenient and economical methods of rearing turkeys on range. Some form of pelleted concentrate and grain feeding appears to offer the best chance of success in this problem.

#### TOBACCO DIVISION

The total 1954 leaf tobacco production in Canada is estimated to be almost 186,000,000 pounds from about 132,000 acres. Of this estimated total 174,000,000 pounds were produced in Ontario; 11,500,000 pounds in Quebec; and 140,000 pounds in British Columbia. The gross revenue to the growers was about \$80,000,000. The total leaf production was about 46,000,000 pounds greater than in 1953 and the gross revenue to the growers increased by about \$20,000,000.

*Irrigation improves flue-cured tobacco.*—Irrigation of flue-cured tobacco at the Experimental Substation, Delhi, Ont., increased the quality 8·5 cents per pound, the yield 371 pounds per acre, and the returns \$338 per acre. These data, collected over the two-year period, 1953-1954, were obtained from tobacco that was irrigated only when additional moisture appeared to be essential for plant growth. It is indicated that a soil moisture deficiency during the last three weeks of July is more harmful than deficiencies occurring during the early stages of growth. One inch of water per irrigation has been found sufficient under most conditions. The experimental work has shown that supplemental irrigation benefits flue-cured tobacco in a dry year, but over-irrigation may reduce the quality by producing a thin, papery leaf that is low in gums and resins and lacking in aroma.

*Potash influences the yield of flue-cured tobacco.*—Four years' results at Delhi indicate that a high level of potash fertilization is necessary to obtain high yields of good-quality leaf. An application of 140 pounds of potash per acre increased the yield of tobacco by 40 pounds per acre over the 100-pound rate, without altering the quality. Heavier applications lowered the quality slightly and tended to delay the maturity. Results from this experiment warranted the recommendation of higher levels of potash in flue-cured tobacco fertilizers for 1955 in Ontario.

*Source of potash important for tobacco.*—Experiments conducted at the Experimental Substation, St. Thomas, Que., show that variations in the relative proportions of the muriate and sulphate forms of potash in the fertilizer have significant effects on the yield and quality of flue-cured tobacco. The all-sulphate treatment produced significantly lower yield, grade index, and acre value of the crop than did one-third, two-thirds, and all-muriate treatments. The all-muriate treatment produced a significantly higher yield than other treatments, and was equal in grade index and acre value to the one-third and two-thirds muriate treatments. However, the all-muriate form of potash had a detrimental effect on the burning quality of the dried leaf. Considering the effects of the fertilizers on yield, grade index, and burning quality of the leaf, the fertilizer containing one-third of the potash in the muriate form and the remainder of the potash in the sulphate form was superior to the other mixtures.

Five years' data are available on sources of potash for cigar tobacco at the Experimental Station, L'Assomption, Que. Variations in the proportions of muriate and sulphate of potash to supply 20, 40, and 60 pounds per acre of chlorine did not have a significant effect on either yield or grade index of the crop. However, the application of 20, 40, and 60 pounds per acre of chlorine significantly decreased the duration of burn in cigar tobacco, as compared with the no-chlorine treatment.

*Chlorine content of flue-cured tobacco affects quality.*—Fertilizers containing 2, 3, 4, and 5 per cent chlorine were compared at Delhi, to determine the optimum level of chlorine in flue-cured leaf. Increasing the chlorine content of the applied fertilizer from 2 to 3 per cent raised the chlorine content of the leaf slightly, which improved the hygroscopic properties of the cured leaf without delaying the time of burn. Five per cent chlorine in the fertilizer raised the chlorine in the cured leaf above the satisfactory level of 1.0 per cent and delayed the burning time.

*Control of nitrogen supply important for flue-cured tobacco.*—The quality and value of flue-cured tobacco have been improved by a reduction in the amount of nitrogen applied at transplanting time. Results obtained at Delhi show that excessive nitrogen tends to produce thin lower leaves that waste under drought conditions and become lifeless during curing, as well as coarse, thin upper leaves that are of poor texture and color. Over the application range of 10, 20, and 30 pounds of nitrogen per acre, with adequate phosphorus and potash, the best quality and highest acre value of the crop without reduced yield were produced by 10 pounds of nitrogen per acre.

*Indirect fertilization beneficial to flue-cured tobacco.*—In the two-year, rye-tobacco rotation in common use on flue-cured tobacco farms, the mature rye straw is disked into the soil in August of the year preceding the tobacco crop. Experiments at St. Thomas show the comparative effects on the tobacco crop of manure and commercial fertilizer applied to the rye straw at time of

disking. The application of 5 tons of manure to the rye straw significantly increased the yield and acre value of the following tobacco crop over all fertilizer treatments except the heavy application of 200 pounds of nitrate of ammonia plus 200 pounds of muriate of potash. The leaf grade, however, was better following manure than following commercial fertilizer. The application of 100 pounds of nitrate of ammonia with or without 100 pounds of muriate of potash significantly increased the acre value of the flue-cured crop over that following unfertilized rye.

*New cultural, harvesting and curing methods improve the burley crop.*—Earlier planting, closer spacing between plants in the row, and higher topping are now recommended for cigarette burley as a result of tests at the Experimental Station at Harrow, Ont. The highest proportion of leaf of smoking grades is obtained when topping the plants is delayed until the majority of the plants are in blossom.

Experimental results warrant a change in fertilizer recommendations from a 5-10-13 mixture to a 5-10-15 mixture for burley tobacco. Also, the band method of applying fertilizer has been shown to be less wasteful of fertilizer material than the broadcasting method.

The cigarette burley crop following alfalfa sod plowed in the fall was increased significantly in value by seeding to rye after plowing as compared with the ordinary plowing of sod without rye.

Recent innovations in methods of harvesting and curing burley have considerable merit. Tests at Harrow show that the Kentucky method of harvesting burley results in considerable saving in time and labor and improved quality of leaf. Growers who used this method in 1954 were among those who received top prices for their burley crop. Investigations show that calcium chloride may be used effectively at low cost for the removal of excess moisture from the curing barn during critical periods of the curing process. The use of propane gas is proving successful at Harrow in a pilot burley curing barn. Results indicate that increased yields, due to greater retention of dry matter, are possible when conditions for curing the crop are maintained near the optimum.

*New varieties maintain burley tobacco production.*—The future of burley tobacco production in Canada now depends largely on a new type which may be used for blending in cigarette manufacture. An extensive breeding and testing program is in progress at the Harrow station, to obtain burley varieties that will produce a high proportion of cigarette leaf. Both the cigarette type and the heavier export type varieties have been re-evaluated. Harrow Velvet, a variety produced at Harrow, currently accounts for 75 per cent of the cigarette type of burley grown in Canada. Tests show that Burley 1, a variety introduced from the United States which contains Harrow Velvet in its breeding, is a promising cigarette type under Ontario conditions. Both Harrow Velvet and Burley 1 are highly resistant to black root rot and yield an average of six saleable leaves per plant more than ordinary burley. Harmony, a Harrow production, provided the major portion of the export burley in 1954. A new strain of the export type named Improved Briar, bred at Harrow by crossing Green Briar and Kentucky 41 burley, will be released for commercial production in 1955. This is the first heavy-bodied black-root-rot-resistant burley variety to compare favorably in quality with the standard black-root-rot-susceptible variety Green Briar. New strains of burley containing lower nicotine content are under test and some of these appear promising. Finally, hybrid mammoth strains of burley are in the process of development.

*Sources of calcium, phosphorus, and sulphur for cigar tobacco.*—The fertilizer elements, calcium, phosphorus, and sulphur, are commonly supplied to tobacco in superphosphate; however, studies at Ottawa over a period of 5 years show that the effects of these elements on cigar tobacco vary with their source. Superphosphate was used as one source and a combination of calcium carbonate, sodium biphosphate, and sodium sulphate salts was the other source. Each source was applied at two rates which were equivalent to 500 and 1,000 pounds of superphosphate per acre. At the lower rate, the combination of salts produced a significantly higher yield and crop index than did superphosphate; but at the higher rate there was no significant difference between the two sources. Analysis of the data for main effects shows that a significantly better average grade index resulted from the combined salts than from the superphosphate when the crop data from the two rates were included. Also, the average grade index, as well as the yield and crop index, was significantly better from the higher rate than from the lower rate when the crop data from the two source materials were included.

*Grade index of cigar tobacco improved by the partial-priming method of harvesting.*—Experiments in harvesting cigar tobacco by the priming method have been conducted at Ottawa for several years using four different varieties. The results show that, with early maturing crops, the grade index may be considerably improved by priming all the leaves, that is, by picking the leaves off the plant as they ripen, compared with the stalk-cutting method. Priming was especially beneficial in seasons of rapid growth when crops were harvested 14 to 18 days after topping in August when the weather conditions are most favorable for air-curing primed leaf.

With late maturing crops when harvesting was delayed three to five weeks after topping, the grade index was not significantly better from priming than from the usual stalk-cutting method. It was concluded that the priming method of harvesting all the leaves was economically impracticable because of this seasonal effect. However, since 1951, the results of the combination method of harvesting 6 to 10 leaves by partial priming and stalk cutting the remaining leaves appear to be more promising. Treatments of 1, 2, and 3 primings totalling 3, 6, and 10 leaves per plant, respectively, were compared with the check treatment of stalk cutting all the leaves. Two and three primings significantly increased both the grade index and crop index. Three primings proved to be the best treatment. On a basis of three-years' data, it resulted in an increase of 2·8 cents per pound and \$110 per acre compared with the check.

*Digestion of leaf protein stops halfway.*—The breakdown of nitrogenous components of tobacco leaves is important in the production of good-quality tobacco. Proteins contain three-quarters of the nitrogen in the fresh leaf, but only half of the protein is broken down during curing.

It was previously thought that, since half of the protein is held in certain bodies within the leaf cells, the digestive enzymes might not be able to reach it. Research at Ottawa has shown that the proteins both within and without the bodies are digested equally well during curing in cigar tobacco leaf. Furthermore, the digestive enzymes are not inactivated when half the protein is broken down. It was found, however, that protein is protected from digestion by leaf enzymes when it interacts with simple sugar to produce a brown colored complex which is often encountered in food technology. The latter series of reactions occurs spontaneously only at the low water contents that leaves reach toward the end of the curing process. It may be possible to control the blockage of protein breakdown with a view to adjusting this factor of quality.

## PUBLICATIONS, MEETINGS AND VISITORS

Efforts are made in every way possible to keep the public, and farmers in particular, well informed of activities at Experimental Farms. Agricultural bulletins, progress reports, press articles, radio broadcasts, television, exhibits at local fairs, talks given at farmers' meetings and demonstrations arranged at Station field days, are all aimed at presenting reliable, up-to-date information on the results of agricultural research. The following summary indicates the extent of these activities in 1954.

### PUBLICATIONS

Reports and bulletins printed or re-printed .....	55
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Annual Report of the Director, 1952-53 (English and French)	
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Annual Report of the Director, 1953-54 (English and French)	
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#### DIVISIONAL PROGRESS REPORTS

Cereal Crops, 1949-53.	
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Forage Crops, 1949-53.	
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Tobacco, 1949-53.	
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#### PROGRESS REPORTS OF BRANCH STATIONS

Charlottetown, P.E.I., 1948-52.	
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Fredericton, N.B., 1948-52.	
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Tower Hill, N.B., 1949-53.	
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Lennoxville, Que., 1947-52.	
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Brandon, Man., 1948-52.	
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Saskatoon, Sask., 1949-53.	
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Melfort, Sask., 1947-53.	
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Indian Head, Forest Nursery Station, Sask., 1947-52.	
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Lethbridge, Alta., 1947-52.	
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Lacombe, Alta., 1947-52.	
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Saanichton, B.C., 1947-53.	
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Fort Simpson, N.W.T., 1947-53.	
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#### BULLETINS

<i>Publication Number</i>	<i>Title</i>
686 .....	Swine Production (Revised)
816 .....	Vegetable Growing (Revised)
847 .....	Apple Growing in Eastern Canada (French)
849 .....	Plum Culture
857 .....	Community Nests
872 .....	Feeding for Market Lamb Production
881 .....	Cost Charges for Agricultural Machinery
900 .....	Poisonous Plants of the Canadian Prairies
901 .....	The Prairie Home Orchard
906 .....	Wool Production in Canada
907 .....	Business Problems of the Small Cannery
914 .....	The Feeding Value of Damaged Grain
917 .....	Cover Crop Tests
918 .....	Potato Growing in Canada

#### General

<i>Title</i>
Garden Rose Growing
Report on Dykeland Reclamation 1913-52
The Experimental Farms Service
Guide to the Experimental Farm (English and French)
Crop Variety Recommendations for the Atlantic Provinces. (The five Experimental Stations co-operating, St. John's W., Charlottetown, Napan, Kentville, and Fredericton.)
Fertilizer Recommendations for Vancouver Island. Exp. Station, Saanichton, co-operating with B.C. Dept. of Agric.)
Standard Vegetable Varieties Recommended for Vancouver Island. (Exp. Station, Saanichton, co-operating with B.C. Dept. of Agric.)
A Brief Outline of Current Experimental Work at Saanichton 1947-53.

**SOIL SURVEY REPORTS AND MAPS** (in co-operation with provincial departments)

1. Hants County, N.S.
2. Montreal-Jesus Island, Que.
3. Bruce County, Ont.
4. Grey County, Ont.
5. Quesnel, Nechoako, Francois Lake and Bulkley Terrace Areas, B.C.

**PRESS AND MAGAZINE ARTICLES, RADIO ADDRESSES, AND TELEVISION PROGRAMS**

Press articles submitted for distribution by Information Service .....	488
Press articles, including news letters, submitted directly to the local press, farm journals, and magazines .....	520
Special feature articles prepared by members of the staff or by writers with the assistance of Experimental Farms personnel .....	101
Radio addresses broadcast .....	335
Television programs .....	2
Separate exhibits prepared for display at fairs and exhibitions .....	103
Days spent by personnel assisting at fairs, field days, and farmers' meetings .....	1,898

**EXHIBITS**

The Experimental Farms Service co-operated with Information Service in the preparation of a number of educational exhibits shown at Class A and Class B Fairs in 1954. In addition 103 separate exhibits were prepared and shown at local fairs. Personnel were supplied to assist in staffing exhibits and to act on committees and as judges. Members of the staff spent a total of 1,898 days in assisting at fairs and exhibitions.

**VISITORS AND FIELD DAYS**

Superintendents and staffs of Experimental Stations worked in close co-operation with representatives of provincial agricultural extension services in organizing field days and arranging visits of groups of farmers and agricultural societies to Experimental Stations. This has proved to be a very effective means of disseminating information on research activities. The large number of visitors indicates a high degree of interest in agricultural research. Some 1,256 groups and organizations comprising 99,010 persons were received in 1954. In addition over 600,000 casual visitors were reported. Some 156 field days, with a total attendance of 11,764 farmers, were conducted on Illustration Stations.

**SCIENTIFIC AND TECHNICAL PAPERS**

Scientific and technical papers presented at conferences and meetings (not published) .....	498
Scientific and technical papers published (listed below) .....	251

**ANIMAL HUSBANDRY DIVISION**

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### Research

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## EXPERIMENTAL FARMS SERVICE

*Continued from Inside Front Cover*

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